

**EXCLUSIVE!**

**INSIDE AVIATION'S TRIAL OF THE CENTURY** p.46

# AIR & SPACE

Smithsonian

## Out There

44 YEARS OF SPACEWALKS

**Why Robots  
Want Your  
Airspace** p.52

**UFOs –  
in 1909**

**Plutoville:  
The Solar  
System's  
Gritty  
Outskirts**

JULY 2009





# Better Than FREE?

**Stauer gives back! Get our 6-carat French Pear Pendant for \$195 and get \$200 in gift coupons!**

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Despite tough economic times, Stauer has had a very good year. Now it's time to give back. That's why when you purchase the DiamondAura® *French Pear Drop Pendant* Necklace for \$195, you'll receive two \$100 Stauer gift coupons. That's \$200 you can use on any of our hundreds of pieces of fine jewelry, vintage watches and luxury goods. Basically, we're paying you to shop Stauer.

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**The Four Cs.** Our exclusive DiamondAura jewelry has splendid specifications: color, clarity, cut, and carat weight. We won't bore you with the details, but we've invested close to \$6 million in developing DiamondAura. The complex laboratory process involves rare minerals heated to an incredibly high temperature of nearly 5,000° F inside some very modern and expensive equipment. Using chemistry, we found a better way to match the fire and brilliance of a "D" flawless diamond at a much more reasonable cost.

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Clarity	"IF"	<b>Clear</b>
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6 ctw necklace	\$200,000+	<b>\$195</b>

**Sound too good to be true?** Let me explain: at Stauer we don't make money selling one piece of jewelry to you, we stay in business by serving long term clients. Our data tells us that when you become a Stauer client, you'll be back.

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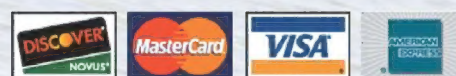
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This is no joke. There is no catch. Simply call our toll-free number or log on to [www.stauer.com](http://www.stauer.com). The first 2500 to respond to this ad will get the *Scienza™* lab-created **Ruby Pendant** absolutely **FREE**. If you're wondering exactly how we can afford to do this... read on.

**Why give away jewelry?** Our real goal is to build a long term relationship with you. We are convinced you will become a loyal Stauer client in the years to come. But for now, in this lousy economy, offering this remarkable pendant seemed the best way for you to give us a try.

The *Scienza™ Ruby Pendant* features an impressive 1-carat oval-cut, lab-created ruby prong-set in luxurious gold vermeil. Surrounding the radiant red oval are 14 brilliant-cut, lab-created *DiamondAura®* dazzlers. The combination sparkles with a passionate fire that is even brighter than most mined stones.

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**It's okay to be skeptical.** But the truth is that Stauer doesn't make money by selling one piece of jewelry to you on a single occasion. Our success comes from serving our long term clients. Be one of the first 2500 to respond to this ad and receive 100% off while getting a closer look at Stauer's exclusive selection of fine jewelry.

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# AIR & SPACE

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**ON THE COVER:** Humans have ventured out of spacecraft since 1965 (p. 33). In this 1994 NASA photo, astronauts Carl Meade and Mark Lee (anchored to the shuttle arm) appear not to see eye to eye on the test of a small propulsive backpack that could rescue an astronaut adrift.



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### On the Web Site [www.airspacemag.com](http://www.airspacemag.com)

News and curiosities from the whole world of aerospace, brought to you by the editors of *Air & Space* in a new blog: "The Daily Planet." **PLUS** a special section commemorating the 40th anniversary of the Apollo moon landing.



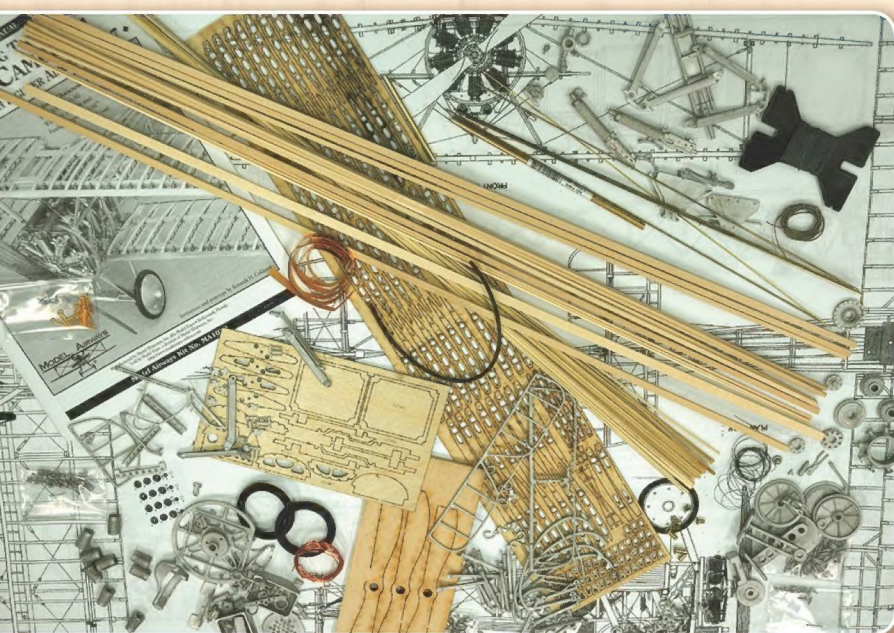
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Includes everything here



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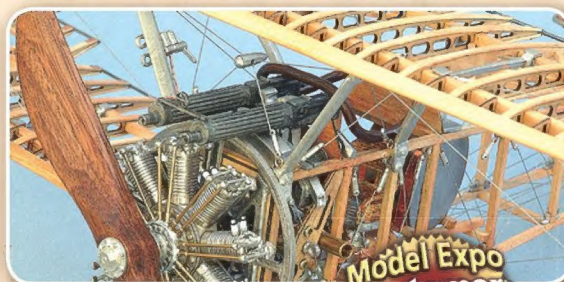
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## July 20, 2009

**ANNIVERSARY CELEBRATIONS** by their nature look backward, but I hope that on the 40th anniversary of the Apollo 11 moon landing, we Americans will consider what that achievement can mean for us today. At the National Air and Space Museum, home of the Wright *Flyer* as well as hundreds of Apollo program artifacts, we're reminded daily that the span from the first flight by the Wright brothers to the first steps on the moon was only 66 years (see *In the Museum*, p. 15). The pace of that technological advance has never been matched. The industry that took that magnificent stride was formed in two world wars and in the years between them, when competition, in the form of national and international air races, spurred exponential progress.

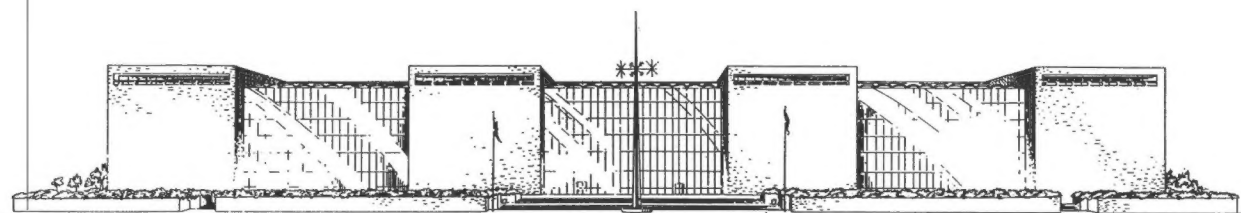
When President John Kennedy in 1961 committed the country to going to the moon before the end of the decade, nobody knew how we were going to do it. At the time, the Soviets were beating us in every category. They had launched the first satellite and the first man into space. Later, they beat us to the first spacewalk (see "Step Outside," p. 33). But America rose to the challenge. If you read any of the books describing the efforts leading up to that moon landing, you can't help being impressed by the steadiness with which the plans were executed. Step by step, test after test, the cast of thousands working on the Ranger, Surveyor, and Lunar Orbiter programs and on the Mercury, Gemini, and Apollo missions taught themselves

how to get to the moon. I've heard that you couldn't tell the NASA employees from the contractors because they were completely integrated in a classic example of what can be done as a team.

Not that working on Apollo was any Sea of Tranquility. You read stories about contractors and NASA employees working nights and weekends. So that they wouldn't waste time going home, they slept in their work areas—on the floors of plants where the enormous rocket stages were assembled and in the labs where delicate, complicated spacecraft that looked like nothing anybody had seen before took shape. Under staggering pressure, engineers tussled over hardware designs and mission profiles, and there must have been at least one time in the experience of every single person involved with the program when he or she thought, "We're not going to make it."

I think there's a lesson there for us. Today we're in a tough situation: Unemployment is high, the financial system is shaky, and we're all worried about the future. But if we look back to see what our predecessors did under unbelievably difficult conditions, we might realize that today's struggle is another opportunity for Americans to do what we've done so well in the past: Invent, keep our eyes on the goal, get the job done. The Apollo artifacts in the Museum on the Mall and at the Steven F. Udvar-Hazy Center in Virginia prove that whatever we Americans put our minds to, we can do.

■ ■ ■ J.R. DAILEY IS THE DIRECTOR OF THE NATIONAL AIR AND SPACE MUSEUM.







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# Letters

WRITE TO US

## Lore of the Intruder

"Shoulder to Shoulder" (Apr./May 2009) made me recall a story my dad, a Grumman engineer, told us about the Intruder's first flight. The company was so sure of the new A-2F (later A-6) that it invited Navy officials to witness the maiden flight

at its Bethpage, New York plant. But problem after problem arose, and after hours of engine starts and shut-downs, the Navy people retired to their hotel.

"Corky" Meyer, the Grumman test pilot, was walking out the door in his business suit when engineers asked him to try an aborted takeoff. He agreed, but once he was moving, the controls felt so right that he lifted off for one quick turn around the pattern. Then, in an instant, he decided to fly gear down to Calverton, a naval facility 50 miles east, and demo the Intruder to the Navy there.

Unfortunately, the engine starts had eaten a lot of fuel, and the tanks were only partly filled. The port engine died three miles out, the starboard engine died on short final, and Corky lost hydraulics at touchdown. So the aircraft's first landing was dead stick, and with no torso harness—Corky wasn't even strapped in.

Cdr. Ray Ross, U.S. Navy (ret.)  
Montrose, Colorado

I heard another reason side-by-side seating is advantageous. While in flight training at Naval Air Station Pensacola in the late 1970s, I was told the following story by the participants, who shall remain nameless.

An A-6 crew from the East Coast had flown to Naval Air Station Dallas for a training flight. They enjoyed all the

city had to offer, and come the next morning, the fuzzy-eyed crew took off for home. Once at cruising altitude with autopilot engaged, the pilot and bombardier/navigator eventually fell asleep and motored past the East Coast and out



over the Atlantic.

One of them woke up and, seeing nothing but ocean, punched the other in the ribs. They U-turned for home and landed safely, though when they arrived they had lots of explaining to do.

Will Samples  
Dallas, Texas

## Power Struggle

The account of my flight in an airplane fueled by bio-butanol ("Nobody's Fuel..Yet," Moments & Milestones, Feb./Mar. 2009) says I lost control on landing. While there were significant winds, I did not lose control; I lost power, altitude, and options, in that order. I barely made the airport at all, and was forced to land perpendicular to the runway on a taxiway.

Leonard Johnson  
via e-mail

## Props for Porps

I was delighted to see that Fred W. Porps is alive and kicking ("Homage," Flights & Fancy, Apr./May 2009). I too was his student back in the mid-1970s and found him to be droll, smart, and

# AIR & SPACE

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## Letters

one heck of a pilot. We flew together at a time when training no longer required spins, but good ole Fred wouldn't let me proceed until I not only learned to recognize the onset of a spin but could do them and recover with a skill and reflexes I thought I no longer had. When I got my ticket, he gave me a silvered belt buckle with wings and a quotation inscribed on the back that is vintage Porps: "Blue Side Up."

Allan Mirkin  
Lake Montezuma, Arizona

### Russian Rarities

Readers should know that the Military Aviation Museum in Virginia Beach, Virginia, has three aircraft from the Spanish Civil War ("The War Between the Wars," Apr./May 2009): a Polikarpov I-15B, I-15bis, and I-16.

G. Robert Veazey Sr.  
Wilmington, Delaware

### Following the Story

As a young teen, I'd scan the sky above the Hollywood Hills for the KTLA Telecopter or the KMPC traffic helicopter ("Zoom Shot," Apr./May 2009). I wrote to the stations hoping for autographed photos of the pilots, Larry Sheer in the Telecopter or Captain Max Schumacher of the KMPC Bell 47 helicopter. One day, I received not just a photo, but an invitation to their hangar at Van Nuys Airport.

Over the following years I would visit and occasionally get a flight in the KMPC helicopter or the station's Beechcraft Travel Air. No passengers were allowed in the Telecopter because

weight was a factor. In fact, some of the early Telecopters had to roll on the wheels of their skids to get airborne.

There are a few sad twists to those pioneering helicopters and their pilots: Captain Max was killed in a collision with a police chopper in 1966. KTLA's first JetRanger Telecopter was sold to TV rival KNBC. It was this aircraft that Francis Gary Powers, who had survived when his U-2 was shot down over the Soviet Union, was piloting when he ran out of fuel and crashed in 1977. But those news choppers set me on my way for the next 45 years as a radio and TV news pilot and reporter.

John Iander  
Latrobe, California

### Corrections

*Apr./May 2009 Sightings:* The ILC Industries' A-5L prototype pressure suit was not "light-years ahead" of the Litton Industries RX-3 prototype. The A-5L, used for the moonwalks, was a "soft suit," while the RX-3 was a highly advanced hard suit.

"Hit Me With Your Best Shot":  
(1) The P-51 was shot at the Salinas Municipal Airport in California, not the gathering of Mustangs in Columbus, Ohio. (2) The fighter on pp. 56-57 is a MiG-15, not a MiG-17.

"Soon to Be Super Again"  
(Soundings): The Lufthansa foundation's Lockheed L-1649As are Super Stars, not Super Constellations.

*Feb./Mar. 2009 "Thuds, the Ridge, and 100 Missions North."* (1) We regret misspelling John Giraudo's name. (2) A total of 228 F-105s crashed in North Vietnam, not 99. (3) F-105 no. 62-4372 crashed in 1981, not 1980.

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## Sea Trials

**>>> WHEN IT COMES** to being rescued after splashdown, astronauts are fussy. “The crew doesn’t like it if you don’t pick them up,” jokes Don Pearson, a project manager at NASA’s Johnson Space Center in Houston, Texas.

That’s why parajumpers from Air Force Special Operations Command gathered around a 26-foot-deep pond at the Naval Surface Warfare Center in Bethesda, Maryland, on a cold day last March. They practiced attaching a flotation collar and sea anchor to a 17,000-pound full-scale model of the Orion crew capsule, which has an interior volume nearly twice that of the Apollo capsule.

In 2007, NASA approached the Navy



center’s Carderock Division about testing scale models of the capsule, in preparation for returning to the moon in 2020.

“Carderock is really a one-stop shop,” says Todd Carrico, a naval architect and the project’s lead test engineer. The facility

**An Air Force Special Operations parajumper preps a full-scale model of the Orion crew capsule for a night retrieval test, in case the real thing settles into an ocean after hours.**

offered NASA the use of its tow tank and pond for various tests, and built the full-scale mockup as well.

“We’re not just replicating the shape of the capsule,” explains Carrico. “We’re also replicating the mass properties.” In the quarter-scale model experiment, the center tested a successful splashdown, in which a capsule remains intact and dry on the inside. “But,” says Carrico, “we also tested worst-case scenarios—the capsule is damaged upon impact, and starts taking on seawater.” Ballast conditions were also simulated. “There was one test for a reentry where the capsule is very light, because they’ve used up all their fuel and consumables,” Carrico adds,

“but we also tested one that would be akin to NASA having an abort launch, where the capsule would be fully laden.”

The quarter-scale capsule was also taken to the U.S. Army’s Aberdeen Proving Grounds in Maryland and tested in various simulated sea states. “We wanted to see if the motion of the seas would hamper the rescue divers,” says Richard Banko, senior project engineer, “and sure enough, anything after Sea State Four [eight-foot waves], things become kind of nasty.”

After two weeks of at-sea testing near Florida’s Kennedy Space Center, the Carderock team will build a second capsule for NASA, to be used at the Neutral Buoyancy Lab in Houston.

### UPDATE

## Upbeat on Solar Power

**STARTING IN 2016**, California’s Pacific Gas & Electric will buy electricity from Solaren Corporation, a California company that will generate power from solar panels in orbit (“Where the Sun Does Shine,” June/July 2008), convert it to radio-frequency transmissions, beam it to receivers in Fresno, and convert it to electricity to feed into PG&E’s grid. Solaren’s Cal Boerman says his company has spoken with United Launch Alliance, a joint venture between Lockheed Martin and Boeing, and envisions four heavy-lift launches to get the power-generating elements in orbit, where they will automatically dock. But can the company get a space-based solar power system up and running in seven years? “Quite a few hurdles to leap,” says the RLV and Space Transport News Web site.



## White Asparagus, Red Planet

»»» **THE BIG QUESTION** at Italy's premier white asparagus festival last March: Would NASA say yes? The white asparagus of Bassano del Grappa, like Champagne or Gorgonzola cheese, is a branded European Union food. For certification, Bassano white asparagus can be grown only within eight villages in northeast Italy—and, NASA willing, on Mars.

That extraterrestrial exception traces back to an offhand comment made last summer by a NASA scientist. The Phoenix Mars Lander had taken a quick taste of the Martian soil and found an unexpectedly high pH, around 8.3. "This is the type of soil you'd probably have in your backyard," said Sam

Kounaves, head of Phoenix's wet chemistry team. "You might be able to grow asparagus pretty well. But probably not strawberries."

Enterprising Italians in Bassano invited the Phoenix team to the annual white asparagus festival on March 19, first day of the local harvest. The plan was to present team members with bushels of Italy's most delectable asparagus—and to persuade NASA to plant Bassano asparagus on the Red Planet.

Because of conflicts with a scientific conference, only Barry Goldstein, a Phoenix team project manager, attended. The festival flew him over and plunged him into an Italian version of



**Barry Goldstein (at right) accepts seeds from Pietro Giorgio Bizzotto during Italy's asparagus harvest festival.**

"Iron Chef": dozens of dishes and infusions with solid, liquid, and pureed white asparagus. One local even served him white asparagus gelato. "I thought, *You've got to be kidding me. I'm not touching this stuff,*" Goldstein says, but actually, he admits, it was pretty good.

Goldstein was dazzled by Bassano, but he couldn't accept the seeds for Mars.

International space treaties prohibit bringing organic material to another planet, and scientists looking for life there wouldn't want to bring it anyway. Because of customs laws, Goldstein couldn't even bring seeds home to California.

No matter. The Italians thanked him anyway, for the publicity.

■ ■ ■ SAM KEAN

### WORK IN PROGRESS

## Willkommen!

Last fall, the Dornier Aerospace Museum held a "topping out" ceremony for its brand-new hangar, next to Friedrichshafen airport, which will open to visitors on July 24. "The Dornier Museum is not only an emotional experience for technology lovers," says Cornelius Dornier, son of company founder Claude. "We want to inspire all history buffs, inquisitive people, families with children, young people with big ideas, and cause them to think." The hangar, called the Museum Box, presents the history of Dornier woven into the history of air and space travel. It displays a short-takeoff-and-landing utility Do 27, a twin-turboprop utility Do 228, a vertical-takeoff-and-landing jet transport Do 31, and a reproduction Dornier Merkur airliner. A gallery exhibits Dornier accomplishments in the medical industry.



**The Dornier Do X sailed into New York City in August 1931, but it will not make it to the new museum.**

### DORNIER AEROSPACE MUSEUM

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#### Opens July 24

10 a.m.-6 p.m.  
April-September  
10 a.m.-5 p.m.  
October- March  
Admission: 9 euros adults;  
children free



## How to Clear a Bat for Launch

**LAST MARCH**, a free-tailed bat made its way onto the space shuttle's external tank. Did this bat, like humans and monkeys before him, come to NASA's Kennedy Space Center to push the limits of flight? With a record of supporting exploration, regardless of species, NASA set out to accommodate the bat

without jeopardizing *Discovery's* crew.

In 2005, I worked on United Space Alliance's team for assessing solid rocket booster debris during NASA's return-to-flight preparation for STS-114. I spoke with engineers who now work on the debris analysis team. In short, they compared the bat to more common forms of debris, like ice and foam.

According to the waiver for what became "Observation 119-002," the bat from STS-119 was characterized as a "soft body"—not as hard as the ice that can form on the external tank, but heavier than the Tyvek paper that cover the cavities of the orbiter's reaction thrusters. If the analysis

showed that ice and Tyvek covers posed no danger to the vehicle, then the same could be said for the bat.

Using an aerodynamics tool known as Debris Transport Analysis, engineers calculated the trajectory of both ice and Tyvek covers released from where the bat was perched. This analysis was repeated using flight Mach number and how far into flight the bat hung onto the external tank. While none of the simulations showed that ice would strike the orbiter, some showed that the

Tyvek covers would.

Because of the work performed in the wake of the 2003 *Columbia* accident, NASA has a set of criteria to determine if an impact is acceptable, based on factors such as the speed and mass of the debris and the impact angle. Engineers found that the covers posed no threat to the shuttle and its crew. Because they were able to rule out any danger posed by both ice and Tyvek covers, the bat was officially cleared for flight.

JEREMY DAVIS



### UPDATE

## Woodstock to Land at Tempelhof?

**WHILE BERLINERS** dither over what to do with the recently closed Tempelhof airport ("The Village of Tempelhof," *Above & Beyond*, Oct./Nov. 2008), rumors of a Woodstock redux fly. Michael Lang, co-founder of the 1969 Woodstock Music and Art Festival, has said that such concerts are "all speculative ideas," but Media Consulta, a Berlin ad agency, announced in February that "to celebrate the 40th anniversary of the Woodstock festival, two concerts are planned in the [original Woodstock site in upstate] New York and in Berlin," and the iconic airfield "will serve as an ideal backdrop." The lineup for the August 22-23 concert is said to include Santana, Joe Cocker, The Who, Neil Young and Crazy Horse, and the Grateful Dead.

## Wrights, Curtiss Back in Court Again

**>>> RIGHT AFTER** Glenn Curtiss flew his *June Bug* more than one mile on July 4, 1908, Orville and Wilbur Wright filed suit, claiming that Curtiss infringed on their 1906 patent for movable wing surfaces. Curtiss' machine had swiveling wingtips, which Curtiss thought were different enough from the Wrights' system that he shouldn't have to pay. For years the case bounced around the courts, with the Wrights usually winning and Curtiss usually

appealing, until World War I started, and the U.S. government made both parties sign a peace treaty.

New York intellectual property attorney John Lane, a founding partner in Frommer Lawrence & Haug LLP, has spent the last two years reassembling the case for retrial for the Honorable William C. Conner Inn of Court. Inns of Court date back to 15th century England, when mature barristers trained new ones by holding mock trials. In the 1970s, U.S. Chief Justice

Warren Burger imported the concept. When the Conner Inn of Court decided to focus a series of trials on intellectual property, Lane chose *Wright v. Curtiss*.

"The Wright brothers, with the first manned flight, is something that everyone has some connection [to] on an emotional or historical level," Lane explains. The case, he figured, "would be engaging and not boring."

On a March evening, in a courtroom in lower



Manhattan, the Inn of Court is holding a Markman hearing, named for a 1996 Supreme Court case that declared that a judge, not a jury, should hear arguments about the definition of terms used in a patent infringement case. The word they'll argue is "aeroplane," which to the Wright brothers meant "wing."

Wright attorneys Melvin Garner and Robert Morgan present their definition: "A generally planar or flat structure that can provide lift to a flying machine when its leading edge is oriented to have at least a small angle of incidence to the air as it moves through the air." They call Octave Chanute (lawyer Bryan Weber) to the stand, who explains his connection as mentor to the Wrights and is shown several PowerPoint slides of the *Flyer*. He identifies the "aeroplanes" and explains how their tips "warped." Without wing-warping, the Wrights couldn't control the *Flyer*.

Curtiss attorneys Gary Butter and Kevin Murphy present their definition: "The principal structures (the 'wings') used to lift the machine off the ground and sustain the machine in flight." They call Samuel Langley (Lane), who points out the separate control surfaces that swiveled on the tips of each wing.

Judge Barbara Jones takes a vote: Who supports the Wrights' definition? Who supports Curtiss?

For each name, the same number of hands shoot up. In the case of *Wright v. Curtiss*, 100 years later, the jury is still out.

PHIL SCOTT

## Captain Eric Brown

*Former chief test pilot at the Royal Aircraft Establishment, Farnborough, England, and Guinness World Record holder for most types of aircraft flown.*

### **You've flown 487 different types of aircraft. What was your system?**

It evolved from the fact that I flew a large number of German aircraft at the end of the [second world] war. They had a color-code system: all the instruments in the cockpit had colors around the perimeter of the gauge: red for emergency, brown for oil, blue for oxygen. It made life very simple. I therefore tended to daub with pencil around the edge of the gauges these same color codes. And this helped enormously.

But of course there is nothing that will improve your situation better than preparation. There is an attitude amongst pilots that emergencies are a rare occurrence. Well, hopefully that is true. But that's not to say that the emergency won't happen on your first flight. And unless you're prepared for that, you're going to fiddle around.



**Eric Brown at the Berkshire Aviation Museum (above); 1969 Royal Navy portrait (right).**

LEFT: COURTESY SIMON BLACKER; INSET: BRITISH ROYAL NAVY

### **Did you ever have to eject?**

No, I've bailed out, but never ejected. In the summer of 1944, from June to September, roughly, we had a German weapon called the V-1.

[I was going after one in] a very nice fighter, the Hawker Tempest, when the engine seized, caught fire, and I had to get out. But instead of landing nicely on terra firma, I landed in a rather slimy duck pond. When I gathered my parachute and waded, as the Navy would say, to the nearest shore, I couldn't get out because there was a very irate bull in the field beside the duck pond. And it kept me there for a good half-hour.

### **You flew many experimental aircraft. What stands out?**

The most beautiful airplane was a de Havilland Hornet, a scaled-down model of the Mosquito, but with far

more power. We had wonderful American airplanes, your Mustang, and helicopters of the kind Igor Sikorsky flew in the early days.

### **You were sent to Liverpool to collect a new Sikorsky R-4B helicopter, and flew it back to Farnborough without any instruction.**

When I realized that I hadn't got an instructor, that it was up to me to read the handbook, I thought, *Well, Mr. Sikorsky did it, and he's older than I am, why can't I do it?* What I hadn't realized was that when Mr. Sikorsky did it, he was in a tethered aircraft. And here was I in a free aircraft. Believe you me, I used every inch of that airfield.

The two of us sent up to collect these were reading the handbook, and the other fellow suddenly said, "Do you know, this is like reading your own obituary."

Read the entire interview at [www.airspacemag.com](http://www.airspacemag.com).



# In the Museum

STOPS ON A TOUR THROUGH AMERICA'S HANGAR

## Fashion Lighter Than Air

**THE INVENTION OF THE BALLOON** struck the men and women of the late 18th century like a thunderbolt. In the fall and winter of 1783, Parisians gathered in unprecedented numbers to watch fellow human beings venture off the earth for the first time. On

December 1, 1783, as many as 400,000 people—half the city's population—swarmed into the area around the Château des Tuileries to watch a

hydrogen balloon carry J.A.-C. Charles and M.N. Robert into the heavens. Guards struggled to restrain the crush of citizens clogging the narrow streets, alleyways, and garden paths leading to the launch area. In search of good vantage points, people scrambled up lampposts and onto walls, clambered over fences, and climbed out windows onto roofs.

Across Europe, people were overcome with balloon mania.

Parisians sipped Crème de l'Aérostique liqueur and danced the Contredanse de Gonesse in honor of the village where Charles and Robert returned safely to earth. Balloons inspired hats, hair and clothing styles, jewelry, snuffboxes, wallpaper, chandeliers, birdcages, fans, clocks, furniture, tableware, and more.

A world-class collection of late 18th century consumer goods

commemorating the birth of the Air Age is on view at the National Air and Space Museum's



Steven F. Udvar-Hazy Center in northern Virginia. Visitors can see a set of balloon-back chairs with embroidered seats illustrating the great events of early

balloon history, as well as chests of drawers, dressing tables, and writing desks with intricate wood inlays depicting the launch and landing of the first aeronauts.

U.S. citizens heard about the new field of aeronautics from American diplomats living in Paris who were caught up in the excitement. "All the Conversation here at present turns upon the Balloons...and the means of managing them, so as to give men the Advantage of Flying," Benjamin Franklin wrote. One of his associates commented that among "all our circle of friends, at all our meals, in the antechambers of our lovely women, as in the academic schools, all one hears is talk of experiments, atmospheric air, inflammable gas, flying cars, journeys in the sky."

Franklin reported that small balloons made of scraped animal intestines were being sold "everyday in every quarter." His grandson, William Temple Franklin, released one of these little gas bags in his bedroom, where it "went up to the ceiling and remained rolling around there for some time." Grandfather Benjamin emptied the membrane of hydrogen and forwarded

**A balloon-back chair, left, c. 1785; a paper fan (above) shows an aerialist ascending. The jug, opposite, depicts Étienne Robertson's 1803 claim – probably false – to have reached 23,526 feet.**





## ARTIFACTS

# 40 Years Since Apollo 11

**JUST 66 YEARS AFTER** Orville Wright flew 170 feet along the dunes of Kitty Hawk, Apollo 11 astronauts Neil Armstrong, Buzz Aldrin, and Michael Collins blasted toward the moon atop a Saturn V rocket. Collins, the command module pilot, spent 24 hours on his own in *Columbia*, orbiting the moon while Armstrong and Aldrin explored the lunar surface. "I knew I was alone in a way that no Earthling has ever been before," Collins would later observe. The three returned to Earth on July 24, 1969; the command module was given to the National Air and Space Museum in 1970. For years it was displayed directly beneath the Wright *Flyer* (which now has its own gallery), allowing visitors to move from the Aerial Age to the Space Age in a glance.



it to English friends, along with instructions for generating hydrogen to fill it. That winter, Franklin visited a friend's home for "tea and balloons," and attended a fête at which the duc de Chartres distributed "little phaloid balloonlets" to his guests. At another memorable entertainment, staged by the duc de Crillon, the aging diplomat witnessed the launch of a hydrogen balloon some five feet in diameter that kept a lantern aloft for more than 11 hours.

Sixteen-year-old John Quincy Adams, one of the youngest members of the American diplomatic community in Paris, also mentioned the small balloons that street venders were selling. "The flying globes are still very much in vogue," he wrote on September 22, 1783. "They have advertised a small one of eight inches in diameter at 6 livres apiece without air [hydrogen] and 8 livres with it... [S]everal accidents have happened to persons who have attempted to make inflammable air [hydrogen], which is a dangerous operation, so that the government has prohibited them."

Why the excitement? For many, the colorful balloons rising over the rooftops of Paris symbolized a new era in which science and technology



would effect startling change. The balloon was proof that a deeper understanding of nature could produce what looked very much like a miracle. What else was one to think of a contrivance that would carry people into the sky? And if men and women could break the chains of gravity, could they not also cast off the shackles of tyranny? Across the Atlantic, Americans were demonstrating that ordinary citizens were perfectly able to

govern themselves without the assistance of a king. Among the people of France and England, discontent was bubbling away just beneath the surface. The balloon seemed to be the harbinger of a liberating new age.

The balloon-related objects filling several large cases at the Udvar-Hazy Center are some of the Museum's oldest items. They are reminders of a time when flight was new and the sight of human beings flying through the air still seemed nothing short of miraculous.

TOM D. CROUCH

## Visitor Information



**Family Day** "Become a Pilot Day" takes place on June 20 at the Museum's Steven F. Udvar-Hazy Center in northern Virginia. Dozens of visiting vintage, recreational, military, and homebuilt aircraft will be on display. Visitors can talk to pilots, meet model airplane experts, and check out flight simulators. The event runs from 10 a.m. to 3 p.m. Admission is free; parking is \$15.



**Star Party** Join Museum staff astronomer Sean O'Brien from 8:30 p.m. to 11 p.m. on two Saturdays, June 13 and July 25, in observing celestial objects in skies unpolluted by city lights. Sky Meadows State Park, Virginia. Parking fee: \$4 per car. Park phone: (540) 592-3556.



**What's Up** Receive regular updates on Museum events, read about artifacts, get detailed (and behind the scenes) exhibition information, and receive calendar listings, all by subscribing to the National Air and Space Museum's free monthly e-newsletter, *What's Up*. Sign up at [www.nasm.si.edu](http://www.nasm.si.edu).



## Too Much, Too Soon

**IN 1941, WHEN IT APPEARED** that Britain's battle against Germany might fail, the U.S. Army Air Forces called for a bomber that could fly 10,000 miles with a 10,000-pound payload. Northrop responded with the XB-35 Flying Wing; Consolidated offered the XB-36 Peacemaker.

In 1947, my boss, Colonel Albert "Bullet" Boyd, chief of the Army Air Forces Flight Test Division at Wright Field in Ohio, sent Glenn Edwards, Danny Forbes, and me—"los tres amigos"—to the barren California wasteland known as Muroc Army Air Field, along with civilian flight test engineer Richard Smith. We shared Danny as copilot. We had all the fun of flying, and Dick Smith had all the work of reducing our collected data into readable form.

I was supposed to have flown the propeller-driven version of the Flying Wing, the XB-35. But I had told Colonel Boyd that any engineer who put a propeller on the trailing edge of a wing did not deserve his diploma. The air flowing over the top of the wing has a different temperature, velocity, and dynamic pressure than the air flowing under it, so those little propeller blades had to cut through two different air masses in microseconds, and the difference caused flutter.

The Army Air Forces decided the XB-35 needed jet engines, so Northrop converted two -35s to YB-49 all-jet Flying Wings. No. 42-102367 was instrumented for stability and control; no. 42-102368 was built for performance flight tests. In early 1948, my crew—copilot Danny and flight engineer William Cunningham—flew no. 368 from the Northrop factory in Hawthorne to Muroc to begin performance tests.

Early tests consisted of finding the best speed for takeoff, climb, stall, opening the bomb bay doors, and landing. Each test had its own set of problems—some minor, some that almost killed me. On my first takeoff, the airplane accelerated too rapidly, causing the gear doors to blow off. I could either pull the Flying Wing up at a high angle of attack on takeoff or pull back on the power and wait the 90 seconds for the gear to retract. The problem was that the jet-powered Wing was designed around the propeller-driven XB-35, which operated at slower speeds. Northrop had simply swapped prop engines for jets, and of course the speed of the aircraft increased.

After leveling off, I would be rocked back and forth in my seat in unison with the sloshing of the fuel that was

on the wingtips with the rudders, and he advised me that I might get a full wing stall if I were to trim the entire split flaps either up or down, rather than use the yoke.

Along with getting the Flying Wing to stall, I also got the ride of my life.

I leveled the YB-49 at 20,000 feet, pulled back on the throttles, and waited for it to stop flying. Because most of the shudder you get in a stall comes from the tail, not the wing, I knew I wouldn't get a big shudder. Sure enough, when the tailless airplane quit flying, instead of the normal shudder just before the nose drops, I experienced a violent pitch forward into a negative-G tumble, which pulled my rear end out of the seat. In a microsecond, I realized that I had no aerodynamic flow over any control surface that would allow me to

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**President Truman inspected the Flying Wing. While I was showing him the interior, he turned to me and said, "Looks pretty good to me, son. I think I'm going to buy some." I bit my tongue and just smiled.**

stored behind me in a big rubber bag, with no baffles, buried in the wing. I tried opening the bomb bay doors—they were sucked right off.

Concerned about the upcoming stall tests, I consulted Paul Bikle, chief of the Flight Test Division's performance engineering branch, who told me I would not get a clean stall with the YB-49—I'd get a wingtip stall. He said that unlike the airflow over a standard wing, air over the Flying Wing would be pushed sideways, or span-wise, and as the flow increased toward the tip, lift at the wingtip would rapidly decrease, causing the wing to pitch up. The split flaps were

recover. It was as if you took a nice, crisp, clean dollar bill out and let it go; it would go spinning around its center. The engineers later called it a lateral roll and said I had encountered inertial coupling.

Fortunately, the throttles were mounted up above my head, not down on the console where they normally are. There were two handles, one for the four left engines and one for the four right, just an arm's length away. I was able to grab the left throttle and apply full power, which caused the aircraft to cartwheel. I was thrown into an inverted spin—one thing I knew how to get out of. I recovered at about



800 feet. After I landed, I wrote a brief report: "This aircraft is never to be intentionally stalled." Later that night, I went to Pancho's Happy Bottom Riding Club for a drink.

On June 5, 1948, Glenn Edwards and Danny Forbes were killed at Muroc while flying YB-49 no. 368. It hit the ground upside down, so flat it didn't have much of a sideways motion. The wing areas outboard of the engines were found 15 miles downstream.

Colonel Boyd told me to finish the tests in the other airplane.

In the fall of 1948, I flew no. 367 in a series of stability and control tests. The YB-49 was beautiful—it was just like flying a fighter. But it was not a bomber, and it had many deficiencies: The biggest problem was that it was way ahead of its time, well before the advent of computers. The sensory and response capabilities of a human were too slow to keep up with the Flying Wing's ever-changing dynamics. I've been accused of saying the YB-49 was unstable, but what I actually said was that it was marginally stable about all three axes and could go unstable at aft-center-of-gravity loadings. That's why I would not sign off on the airplane. The YB-49 would have to wait for technology to catch up.

In November 1948, I briefed Air Force generals about my concerns. In the audience was Jack Northrop. After I spoke, he stood and said, "I have the highest regard for Major Cardenas and his abilities as a test pilot. Obviously I have not been kept informed." He looked at the people he brought with him. "It looks like Northrop has a lot of work to do," he said. An engineer in

the audience said, "You have an impossible task," to which Mr. Northrop replied, "General, I'm surprised you have people in your employ who think the impossible really is impossible." That sort of broke up the hearing.

On February 9, 1949, I was ordered to fly the YB-49 to Andrews Air Force Base, near Washington, D.C., for President Harry Truman's air power demonstration. We flew nonstop to Andrews in four hours and 20 minutes, setting a transcontinental speed record. President Truman inspected the Flying Wing and even climbed up in the cockpit. While I was showing him the interior, he turned to me and said, "Looks pretty good to me, son. I think I'm going to buy some." I bit my tongue and just smiled. The president asked the chief of the Air Force, "Why don't you have this young whippersnapper fly this down Pennsylvania Avenue at treetop level? I want the people to see what I'm going to buy." I knew my boss was never going to order me to fly a huge experimental aircraft at treetop level over the heart of the nation's capital.

Well, he did.



**The YB-49 demonstrated that putting jet engines on an airframe designed for piston engines made the aircraft faster but not better.**

As I dodged radio towers, I lost track of Pennsylvania Avenue along the way. I never realized how heavily forested Washington was. All the trees made it very hard to see straight ahead as I roared low over the city. Toward the end of my flight I thought I was in the clear—until the big white dome of the Capitol filled my canopy. I abruptly pulled up to avoid smashing into it.

General Boyd sent Major Russ Schlee out to spot-check some of the flight data that Glenn and I had collected. After Russ made three flights in the Wing, he confirmed our data points and concurred with our thoughts on the YB-49. On a later flight attempt, the nose gear collapsed out on a Muroc lakebed, destroying the last of the test aircraft and almost killing Russ. That ended the program.

GENERAL ROBERT L. CARDENAS,

U.S. AIR FORCE (RET.)

AS TOLD TO JAMES P. BUSH



## The Disney War Plan

**THE TELEGRAM LANDED** on the desk of a Manhattan publicist in May 1942.

AM ANXIOUS CONTACT MAJOR ALEXANDER DE SEVERSKY BY TELEPHONE AND MAIL. WILL YOU ENDEAVOR GET THIS INFORMATION TO ME EARLIEST POSSIBLE MOMENT. DEFINITELY ELIMINATE MY NAME FROM ALL INQUIRIES.

The name definitely eliminated was Walt Disney, who wished to speak with the proponent of long-range saturation bombing.

"There is just one target: the whole country," Alexander de Seversky wrote in *Victory Through Air Power*. A Russian World War I ace with a wooden leg, Seversky emigrated to the United States and reinvented himself as an aircraft designer and military critic. His 1942 best seller slammed War Department orthodoxy and advocated crushing enemy nations with massive assaults by "interhemispheric superbombers." Dismissing land and sea offensives as old-school, Seversky urged diversion of resources from the Army and Navy to create an all-powerful air force.

An enthusiast for all things aeronautic and a military hard-liner, Disney proposed to Seversky a film version of his book, with the Russian himself spreading the gospel. "We want to make this a nation of airmen, mentally," Disney told *Hollywood Citizen News* in early August 1942.

Stung by Seversky's book, the Combined Chiefs of Staff marginalized the writer as a self-serving showboater. But they were daunted by Disney's incandescent genius—and pop icon status—and feared his film adaptation, which Disney had pitched to the War

Department in hope of attaining government financing. Emissaries dispatched to "manage" the mogul were not reassured: To an admiral worried that *Victory's* aero-centric doctrine might jeopardize the Navy's battleship program, Disney remarked,



***Victory Through Air Power* proved no victory for Walt Disney, but at least Seversky (right) got some screen time.**

"Gee, you don't really believe in battleships, do you?"

With his American wife and the family cocker spaniel, Vodka, Seversky settled in a bungalow at the Beverly Hills Hotel. The aristocratic Russian went Hollywood casual, insisting everyone call him "Sasha," his boyhood nickname. His Old World accent struck Disney as too opaque for Americans. A crash course in elocution, plus adjustments to the squeaky wooden leg driving soundmen crazy, and he was camera-ready.

Working alongside Disney artists, Seversky sketched roughs of his superbomber: 268-foot wingspan, six 3,000-horsepower pusher-prop engines, 120,000-pound payload. Its 6,000-mile range conveniently spanned an Alaska-Japan round trip. A

dreamplane, point men for the Combined Chiefs scoffed. "There is nothing in this picture that isn't an engineering reality," Disney argued. In fact, the bomber shared DNA with the Douglas XB-19, a big-bomber testbed that flew in 1941, and anticipated the behemoth Consolidated B-36, still on the drawing board.

Fresh from *Bambi*, Disney cartoonists fast-tracked *Victory Through Air Power*. The 65-minute feature blends animation with live-action scenes. After a slapstick aviation flashback, the mood shifts as Seversky appears with moving maps and an enormous globe. Stylized cartoons in combat-emotive themes depict Dunkirk and Pearl Harbor—per Seversky, consequences of "the earthbound mind." He expounds chapter and verse on his illustrated creed of air superiority. In the apocalyptic climax, Alaska-based animated superbombers wreak Disneyesque destruction on Tokyo.


The film was released to mediocre box office, middling reviews, and some relief in Washington: Disney cut Seversky's strident Navy-bashing, belittling of aircraft manufacturers, and snarky remarks about beloved Army Air Forces General Hap Arnold.

Disney fan Winston Churchill arranged a screening for Franklin Roosevelt at the 1943 Quebec Conference. By then, victory through conventional strategy appeared within reach. But one of the film's driving themes, an independent air force, became reality in 1947.

*Victory Through Air Power* lost over \$400,000, and Disney, in his authorized biography, called his involvement "a stupid thing to do." But he believed in aviation, he added. "And for no other reason than that, I did it."

STEPHEN JOINER





# Truly Unique

## Time travel at the speed of a 1935 Speedster?

The 1930s brought unprecedented innovation in machine-age technology and materials. Industrial designers from the auto industry translated the principles of aerodynamics and streamlining into everyday objects like radios and toasters. It was also a decade when an unequalled variety of watch cases and movements came into being. In lieu of hands to tell time, one such complication, called a jumping mechanism, utilized numerals on a disc viewed through a window. With its striking resemblance to the dashboard gauges and radio dials of the decade, the jump hour watch was indeed "in tune" with the times!

The Stauer 1930s Dashtronic deftly blends the modern functionality of a 21-jewel automatic movement and 3-ATM water resistance with the distinctive, retro look of a jumping display (not



*True to Machine Art esthetics, the sleek brushed stainless steel case is clear on the back, allowing a peek at the inner workings.*

an actual jumping complication). The stainless steel 1 1/2" case is complemented with a black alligator-embossed leather band. The band is 9 1/2" long and will fit a 7-8 1/2" wrist.

Try the Stauer 1930s Dashtronic Watch for 30 days and if you are not receiving compliments, please return the watch

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**TWENTY YEARS AGO**, the existence of a distant wilderness beyond Neptune—seeded with tiny planets, dormant comets, and bits of ice and rock—was mere conjecture. There was Pluto, discovered practically by luck in 1930, and that was it. Astronomers photographed squares of the night sky and compared the images to see if anything was moving, but either their technology was not good enough, or they were searching in the wrong place. Or there was nothing more to find.

Then in 1992, after surveying the heavens for seven years, first with cameras and then with progressively more advanced digital imagers, University of Hawaii astronomer David Jewitt, with Jane Luu, one of his former graduate students, identified 1992 QB1. It was an icy object 125 miles in diameter (less than one-tenth Pluto's size), orbiting the sun a billion miles beyond Pluto. "We really had no idea whether there was anything there," Jewitt recalls. "But it was obvious as soon as we saw it." They tracked the object all night, and then the next, before reporting the find to the Minor Planets Center at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts. Long-time center director Brian Marsden was skeptical; he suggested they had found a wandering comet. Jewitt bet him \$500 that, like Pluto, 1992 QB1 was an orbiting object beyond Neptune. Eventually, Marsden paid up.

Since then, scientists have found more than 1,300 objects in this remote, mysterious region, and researchers estimate there are 70,000 of them with diameters of at least 60 miles. Pluto, it turns out, was neither alone nor unique. Today the Kuiper Belt, a region in space between 2.8 billion and 4.6 billion miles from the sun, is one of the hottest topics in astronomy. Named for Dutch-born U.S. astronomer Gerard Kuiper (rhymes with "viper"), who theorized its existence back in the 1950s, the Kuiper Belt defied detection for decades until scientists realized that Pluto was the first signpost.

Kuiper Belt Objects are leftovers from the whirling gas and dust disk that formed the solar system 4.5 billion years ago. Computer models suggest that the end of that process was marked by the outward migration of the planets, and as Neptune moved into its present orbit, its gravity tugged the remaining smaller bits with it deeper into space. Some of the pieces combined to form larger bodies like Pluto, but

something stopped the planet-making process. The models say that in order for larger bodies like Pluto to have formed, there had to have been at least a hundred times more material in the Kuiper Belt than there is now. Somehow that material disappeared, perhaps pulverized in collisions or flung into interstellar space by the gravity of the outer planets.

"Dwarf planets are embryos," says Alan Stern, a planetary scientist at the Texas-based Southwest Research Institute and a former NASA associate administrator for science. "If you have a Pluto-sized object, it should grow to be an Earth-sized object, unless you remove Pluto from the food supply or remove the food supply from Pluto. It is not clear what happened here."

Or where it started. As the conviction grows that Neptune is the reason why the Kuiper Belt is where it is, researchers have become interested in finding out more about the belt's origin and how its chaotic birth prevented other planets from forming. The migration had to have occurred during the final phases of solar system formation and had to have started very far from the sun. Otherwise the ice in the Kuiper

Belt's comets would have evaporated, and Pluto's meager atmosphere would have boiled off. But "we don't know where the shipwreck took

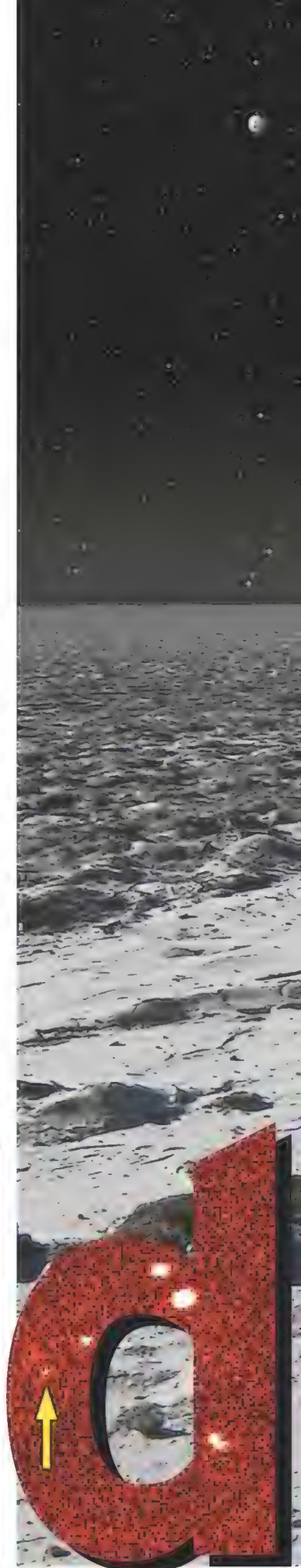
# Where the



place," says California Institute of Technology astronomer Michael Brown, who in 2003 discovered Eris, a Kuiper Belt dwarf planet bigger than Pluto. "Or what happened after that." By the time the migration ended, however, gravitational interactions had brought many Kuiper Belt Objects, including Pluto, into orbital synchronization, with Neptune (Pluto orbits the sun twice in the time it takes Neptune to orbit three times). So whatever happened, Pluto witnessed it.

As the big picture of the Kuiper Belt comes into focus, a team of scientists led by Stern is preparing for a first close look. In 2006, NASA launched New Horizons, a piano-size spacecraft weighing 1,054 pounds, on a nine-and-a-half-year voyage to the so-

**Far out: Pluto's methane ice boils off into its thin atmosphere in a misty scene no human has observed. In the background are Pluto moons Charon and tiny Nix (upper left). Beyond lies the Kuiper Belt, one of the solar system's most mysterious regions.**







# Things Are

**A SPACECRAFT IS ABOUT TO VENTURE INTO THE LAST VIRGIN TERRITORY IN THE SOLAR SYSTEM. BY GUY GUGLIOTTA ILLUSTRATIONS BY RON MILLER**

lar system's outback. So long is its transit and so new is the field of Kuiper Belt study that some of the objects it will examine have not yet been discovered.

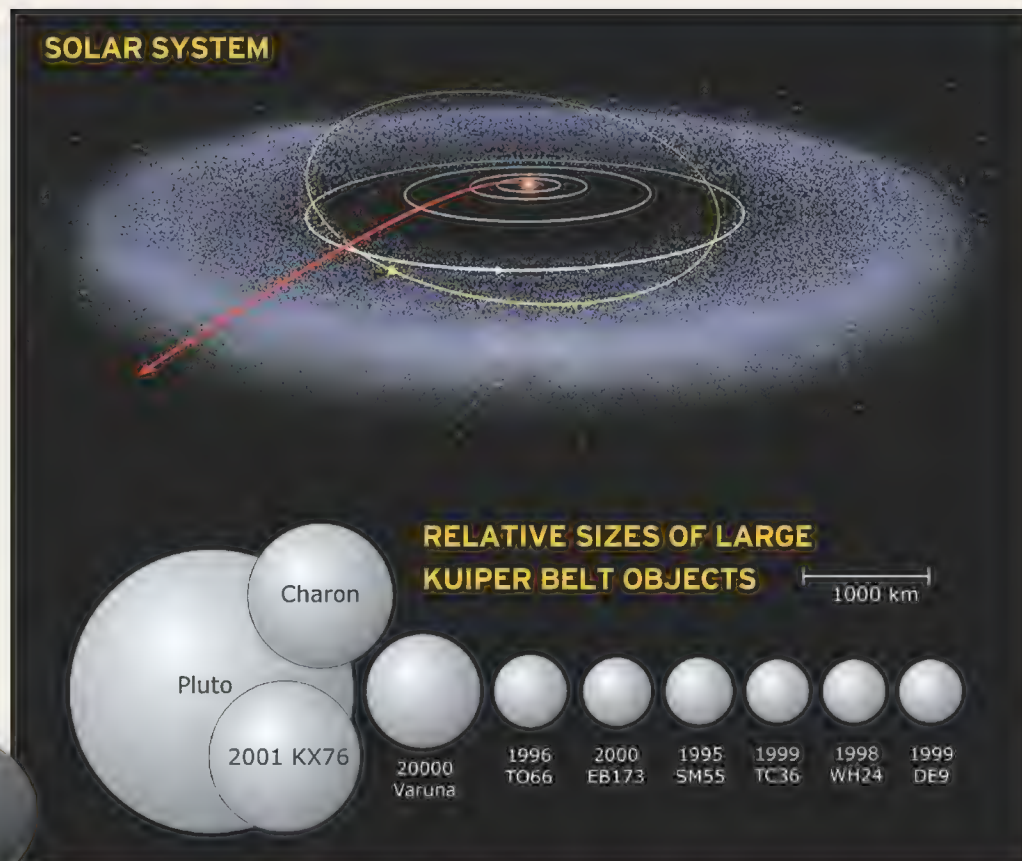
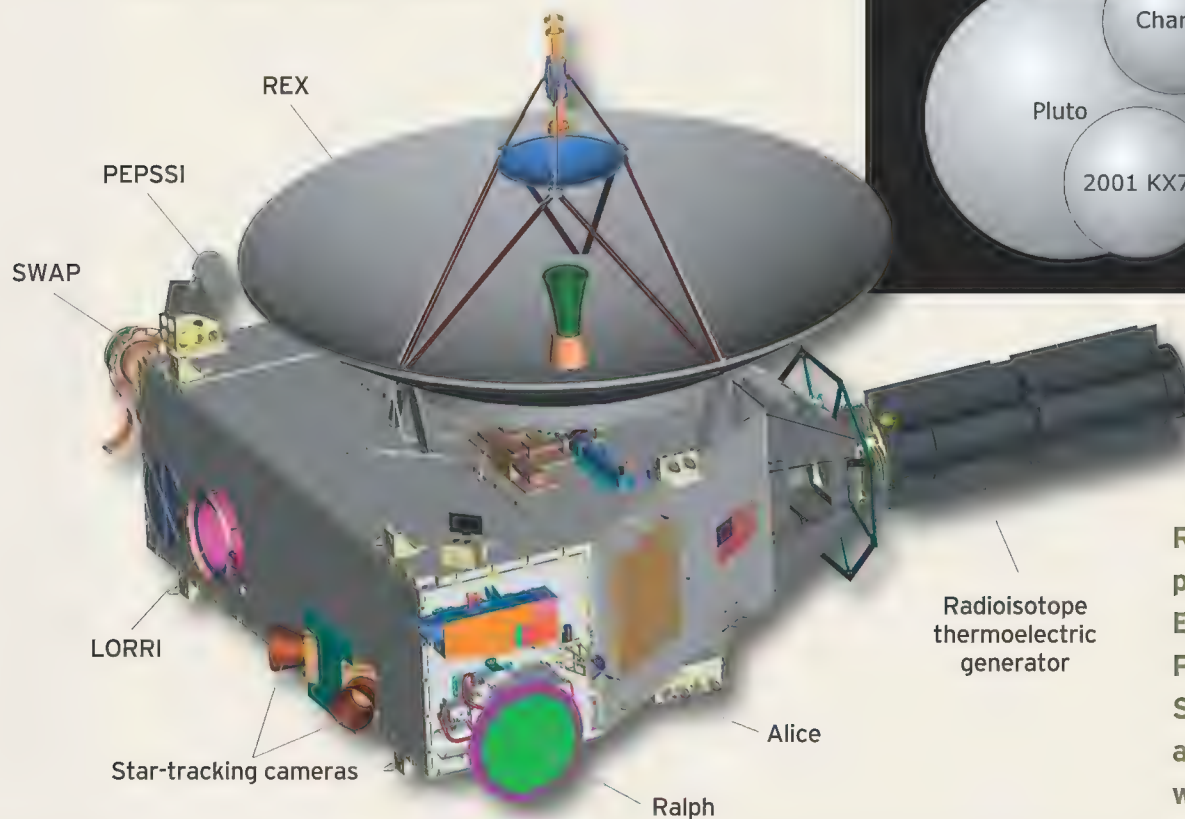
In 2015, the spacecraft will awaken from hibernation for a flyby that will take it within 6,200 miles of Pluto. It will also study Pluto's largest moon, Charon, and two other tiny, recently discovered satellites, Nix and Hydra. New Horizons will take photographs, study Pluto's wispy atmosphere, and analyze its surface, geology, dust, and temperatures. Scientists should then be able to draw at least some general

conclusions about the nature of Kuiper Belt Objects. "I'm sure we'll over-interpret," says Stern, but the flyby will provide information that telescopes cannot get. The impact craters on Pluto's relatively young surface, for example, should give researchers a better idea of the size and number of the objects now in the Kuiper Belt. Because Pluto's surface ices, composed mostly of nitrogen, turn to gas when the planet comes closer to the sun, then refreeze when it moves farther away, the terrain changes seasonally and offers a fresh record of impacts. The surface is



# To Pluto and Beyond

New Horizons carries seven instruments: three cameras, two plasma spectrometers, a dust sensor, and a radio science receiver/radiometer. On average, each uses between two and 10 watts, about the power of a night light. Together, they should give scientists a better understanding of the geology, surface composition and temperature, and atmospheric pressure of Pluto, its moons, and other objects in the solar system's populous wilderness, the Kuiper Belt (right, top). The spacecraft's course (red arrow) will take it beyond



the orbits of Jupiter, Saturn, Uranus, and Neptune (white circles) for an encounter with Pluto (yellow circle) in 2015. Five months before arrival, telescopic cameras LORRI (Long Range Reconnaissance Imager) and Ralph will begin taking pictures, while Alice, REX (Radio Science EXperiment), SWAP (Solar Wind Around Pluto), and PEPSSI (Pluto Energetic Particle Spectrometer Science Investigation) will measure Pluto's atmosphere. After that, it's a hunt for more objects, which may qualify as dwarf planets if they are close in size to Pluto, one of the bigger Kuiper Belt bodies.

relatively "young." Charon, with little or no atmosphere, has a much older surface, so it should have many more craters, and should provide a record of the size distribution of objects in the original belt. By counting the number and size of craters per unit

**With an orbit 248 Earth years long, Pluto does not offer optimum geometry very often. "The Founding Fathers had the last opportunity," says project scientist Hal Weaver. "We didn't want to miss ours."**

of surface, scientists can determine the craters' ages.

In planetary science, the mix of targets is about as good as it gets. Pluto is one of the larger known bodies in the Kuiper Belt, while Nix and Hydra are minuscule. "We have the bookends," says project scientist Hal Weaver of Johns Hopkins University's Applied Physics Laboratory in Baltimore, Maryland, which built the spacecraft. "Here's an opportunity

to get the first look at a completely different class of objects." Weaver, who came to the project because he was interested in "frontier scientific research," describes himself as a "comet guy," and Pluto, he notes, "is nothing more than a big comet."

Imaging of Pluto and preparations for the flyby will start five months before New Horizons' closest approach, but the key portion of the journey is only the 12 hours before arrival and the 12 hours afterward. Downloading all the data to Earth, with a one-way transmission time of four and a half hours, will take nine months. By that time, New Horizons will be on its way to another object. No one knows yet what that will be, but by 2015 there should be a number of candidates.

Right now Pluto is backlit by the constellation Sagittarius, making it impossible to find nearby objects, but by 2011 or 2012 the background will be dark enough for astronomers to begin looking. Stern has not decided whether the team will conduct its own survey or hire a contractor. Telescopes of the new U.S. Air Force-funded Pan-STARRS (Panoramic Survey Telescope & Rapid Response System) project in Hawaii



can image three-quarters of the sky four times a year, and the leader of the outer solar system search, Matthew Holman of the Harvard-Smithsonian Center for Astrophysics, predicts the survey will find between 5,000 and 10,000 Kuiper Belt Objects as big as or bigger than 1992 QB1.

**NEW HORIZONS IS THE FASTEST** spacecraft ever built. It left Cape Canaveral, Florida, on January 19, 2006, aboard an Atlas V-551 rocket, NASA's biggest, with five strap-on boosters. When the last of three stages dropped away, 47 minutes after launch, the spacecraft was traveling 36,000 mph. It passed the moon late that evening, completing in nine and a

half hours a trip that took Apollo astronauts three days. In February 2007, it flew by Jupiter for a gravity assist that hurled it onward at nearly 40,000 mph. Last spring, it passed Saturn's orbit to join Voyagers 1 and 2 as the only functioning spacecraft to traverse the farthest reaches of the solar system.

Planning and executing New Horizons' so-far flawless itinerary has required an unusual combination of rapid response and patience. The orbital mechanics are unforgiving. Pluto is 2.8 billion miles from the sun at its closest approach, reached in 1989. Since then, Pluto has been outward bound, and by the time the spacecraft arrives, it will be about 3 billion miles away. But planners needed to ensure that the space-



Shown with the bluish cloud of the Milky Way behind it, 50000 Quaoar, a Kuiper Belt denizen found in 2002, is thought to be half the size of Pluto and orbiting 3.7 billion miles from the sun.



craft would reach Pluto by 2020; otherwise there was a risk that Pluto would be so far from the sun that its atmosphere—a blend of nitrogen, carbon monoxide, methane, and perhaps other gases—would freeze and the pieces fall to the surface, rendering atmospheric analysis, one of New Horizons’ primary ob-

**NONE OF THIS WAS KNOWN** in 1929, when Clyde Tombaugh, a young astronomer from Kansas, arrived at Lowell Observatory in Flagstaff, Arizona. His task: photograph the night sky through a telescope in hopes of finding a so-called Planet X—so massive that it was thought to be wiggling the orbits of the

giant planets Uranus and Neptune. There was only one way to do this: take long photographic exposures of the same piece of sky over several nights and compare the plates in hopes of finding a faint pinpoint of light that moved. The chore, as any astronomer who has

**Astronomers “might have realized that Pluto was only the first of a large number of unusual objects we had never seen before,” says University of Hawaii astronomer David Jewitt. “That opportunity was lost for 60 years.”**

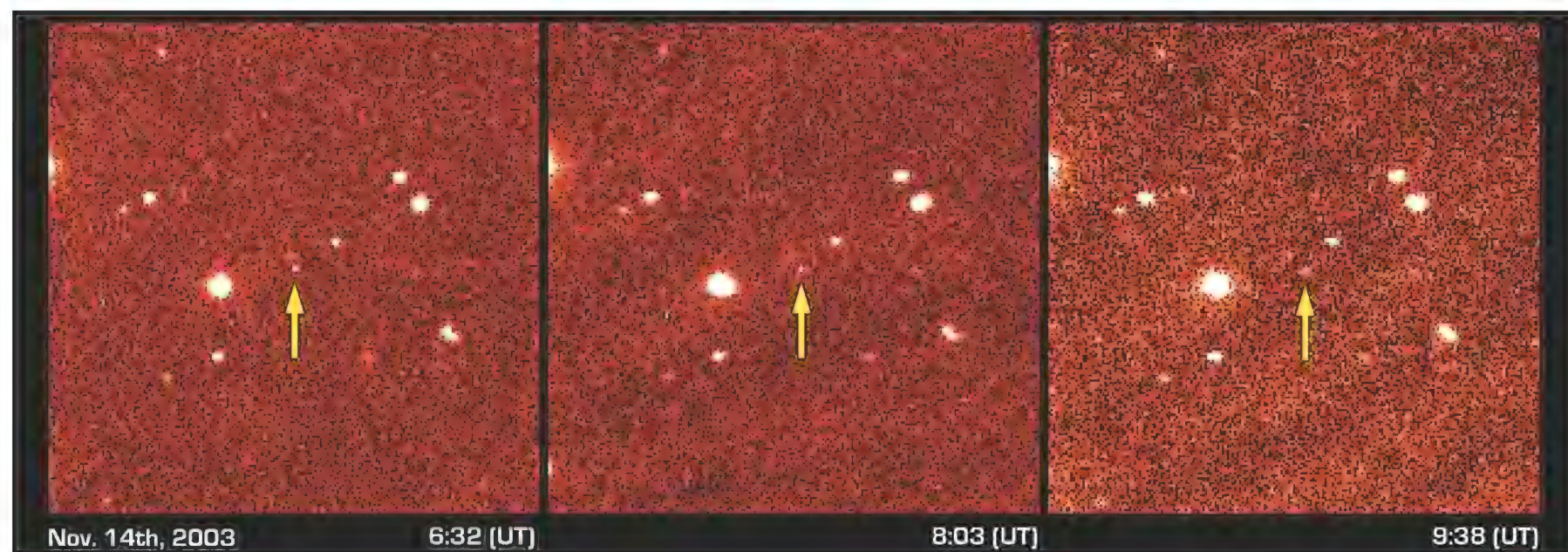
done it can attest, is mind-numbing drudgery, but every Kuiper Belt discovery ever made has used a variation on the theme. The advent of digital imaging in the last 20 years has made the task dramatically easier, but even so, sky surveys are tedious work.

New Horizons has few moving parts. It carries 170 pounds of hydrazine for thrusters that maneuver the spacecraft and point its instruments, and the instruments draw power from a 200-watt—the equivalent energy of two light bulbs—thermoelectric generator fueled by 24 pounds of radioactive plutonium dioxide. Five months before arrival, the spacecraft will begin taking pictures of Pluto and Charon. At its closest approach, New Horizons will be able to discern features as small as 80 feet.

Scientists today know more about Pluto than

done it can attest, is mind-numbing drudgery, but every Kuiper Belt discovery ever made has used a variation on the theme. The advent of digital imaging in the last 20 years has made the task dramatically easier, but even so, sky surveys are tedious work.

Tombaugh was incredibly lucky. He found Pluto on February 18, 1930, after less than a year. The discovery was heralded worldwide, but it was based on a flawed premise. Astronomers learned later that there was nothing wrong with the orbits of Uranus and Neptune—the orbital wobbles were due to errors in measurement—so there was no reason to assume Pluto was massive. And if Pluto was small, there was no reason to think that it had gobbled everything around it. “They might have realized that Plu-



**Astronomers at the Palomar Observatory found Sedna (arrow), three-fourths the size of Pluto, after detecting its slight movement against multiple images of a stationary, starry background.**

any other object in the Kuiper Belt. With a 1,475-mile diameter, it is about a third the size of Earth’s moon. Its orbit is tilted 17 degrees from the orbital plane of the other planets in the solar system. Pluto and Charon, only 12,200 miles apart, are a binary system, locked in synchronous embrace. Both rotate once every 6.4 Earth days. Charon is about half Pluto’s size, while Nix and Hydra, in orbit around Pluto and Charon and between 24,000 and 37,000 miles away, are 10 to 20 percent the size of Charon.

to was not the only thing out there, but only the first of a large number of unusual objects we had never seen before,” says Jewitt. “That opportunity was lost for 60 years.”

But scientists were slowly advancing their understanding of the outer solar system. In 1950, Dutch astronomer Jan Hendrik Oort theorized that there was a huge spherical cocoon of icy debris surrounding the solar system beyond Pluto and extending as far as a light-year away. These pieces, flung out by the giant planets, were the source of “long-period” comets,





which enter the solar system from all angles and have orbits of thousands of years. During the 1980s, astronomers learned a lot more about Pluto, especially during a series of mutual eclipses between Pluto and Charon that lasted five years. The study was made possible because the Pluto-Charon orbital plane could be seen edge-on from Earth, a phenomenon that happens only twice during Pluto's 248-year orbit of the sun. Pluto's color, astronomers found, was yellowish pink, tending toward scarlet. The surface had methane ice, contrasting areas of dark and light, and one or maybe two polar caps. At this point Pluto began to acquire a new identity: a tiny, intriguing outlier. "We began to ask why we should believe that everything stopped at Neptune," says Jewitt. "If there was Pluto, why not something else?"

In 1985, Jewitt and Luu started hunting. They began as Tombaugh had—comparing photographic plates by eye—then switched to charge-coupled devices and digital imaging. "Our first few searches produced nothing, but we kept on looking because the technology kept evolving," Jewitt recalls. "We'd get burned out, but then we'd get a new CCD and get all charged up again."

Meanwhile, in 1989, Stern, a doctoral candidate and Pluto buff, joined several colleagues in what they called a "Pluto underground" to urge NASA to explore the only planet in the solar system that a spacecraft had not visited. Stern says he was convinced

that scientists had "pretty much used up our [astronomical] bag of tricks," and were reaching the limit on what they could determine from telescopes. "There was only one way to learn more about Pluto," he says. "We had to go there." Stern pushed hard through the 1990s, as NASA planned and scuttled four separate Pluto projects before finally awarding the mission to New Horizons in 2001. For \$700 million, the project would use what Weaver calls the "elephant gun" approach: Take the biggest rocket available, make the payload as small as possible, point the gun at Pluto, and pull the trigger.

In 2006, with New Horizons en route, the International Astronomical Union stripped Pluto of its "planet" status, created a new class of celestial body called "dwarf planet," and made Pluto and the newly discovered Eris the first two members. A dwarf planet had enough gravity to be round, the Union said, but was not massive enough to suck up the material in the area around its orbit. Cal Tech's Brown, who had hopes of joining Tombaugh as the only Americans to discover a planet, instead became the second person to discover a dwarf planet. "We're cleaning up a scientific mistake," Brown says. "It's hard to look at the solar system and not quickly come to the conclusion that there are eight large objects, and Pluto is not one of them." Pluto, it turns out, was something altogether different: the gateway to the Kuiper Belt. —

**Pluto (smaller sphere) and its moon Charon are the first guideposts of the Kuiper Belt. They may help reveal why planets long ago stopped forming in the outer solar system.**



# The Six.

A Douglas propliner with more lives than the proverbial cat. by Kara Platoni

**ONE OF THE LAST THREE** Douglas DC-6A Cloudmasters off the line in 1958, the airplane known to its present owners as The Six has entered the most glamorous stage of its storied career: an era of flying for admiring crowds and appearing in big-budget movies. It wasn't always so.

The aircraft got its first major assign-

**Below: The Six (foreground) awaits KLM decals for its role in the movie *Bride Flight*, having first gotten a new paint scheme (below right). Bottom: The DC-6 with the brass and stewardesses of its first airline.**

ment in 1959 with Eagle Airways (later changed to British Eagle), which needed a fuel-efficient workhorse. Working for the airline, the DC-6 had an adventurous youth: It shuttled military personnel home from British H-bomb tests on Christmas Island; it carried men and equipment to Australia as part of the United Kingdom's first rocket programs; and it flew some of the first holiday-package air routes, taking skiers to Innsbruck and sunbathers to Nice. "She's kind of part of every really interesting facet of postwar British society development," says Julian Firth, a pilot with the airliner's present owner, Air At-

lantique. "She's got hooks in everything."

While the DC-6's tube-with-wings design lacked the shapeliness of its chief competitor, Lockheed's triple-tail, porpoise-body Constellation, as well as the speed and range of its follow-on, the DC-7, its excellent operating costs and reliable Pratt & Whitney R-2800 engines endeared it to airlines. "The DC-6 was the apex of the development of the piston-engine airliner," says Bob van der Linden, chairman of the National Air and Space Museum's aeronautics division. "The DC-6 was in service long after the Constellation was out of service, and that's because of the



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SQUARE ROOT EVENTS

engines.” Even after jets replaced piston engines, smaller operators continued using DC-6s; around 15 still fly today, mostly in Alaska as cargo craft.

Unfortunately, DC-6s also started a few fires. When fuel was transferred between tanks, it could overflow, get sucked into the air intake scoop of the cabin heater, and ignite. After two such fires, the airplane was given a different fuel system.

In 1964, British Eagle sold the DC-6 to Saudi Arabian Airlines. The airplane was later given to Yemen Airways. In 1987 it was sold to Air Atlantique. The company, which had started as a hangar operator, evolved to offer air taxi, oil spill cleanup, and cargo services. By 2004, faced with cheaper competition from Eastern European companies, Air Atlantique withdrew The Six from cargo operations; today the company operates a “safari park for classic aeroplanes” in Coventry, England, and offers pleasure rides in vintage aircraft. In 2006, Air Atlantique started a rejuvenation program to help give The Six a new career as well: star of movies and airshows.

Firth estimates that the spruce-up, performed in the Coventry hangar and overseen by vintage-aircraft restorer Ben Cox, took about two years and \$1 million. But,

he points out, “That’s essentially just maintenance dollars—we’re not talking about a major overhaul here. This is work to keep a good old girl flying.” Some adjustments were made to please a photo-taking airshow audience, like replacing a flap selector valve that leaked, causing the flaps to droop after a few hours on display. Air Atlantique also replaced the horizontal stabilizer and corroded fuselage panels.

Air Atlantique owns a second DC-6 that it can temporarily cannibalize for parts, but Firth says the group still spent time scouring the world for replacements, hoping to keep both airplanes airworthy. Since smaller parts like brake pads and tires are in increasingly short supply, DC-6 operators trade among one another.

The Six made its movie debut in 2006’s *Casino Royale*, posing in the background as James Bond thwarts a plot to blow up an aircraft prototype. The Six next appeared in 2008’s *Bride Flight*, portraying a KLM DC-6 flying a race while carrying young Dutch women from London to New Zealand to be married. The Six also has a burgeoning airshow career. Last summer, it was guest of honor at the British Eagle employee reunion at the Farnborough Air Show. Because 2008 was its 50th

**At a 2008 motorcar and aircraft show in West Sussex, England, The Six and its pilot, Julian Firth (in white flightsuit), greet dignitaries such as Norman Turnball (left), the aircraft’s flight engineer from 1959 to 1964.**

birthday, Air Atlantique dressed The Six in its original red-and-white British Eagle livery. Says company archivist Eric Tarrant, “To see the great Eagle symbol airborne again certainly brought a lump to my throat.”

Air Atlantique plans yet another life for The Six: It will fit the interior for about 40 passengers so the aircraft can reprise an older role: as a tourist airplane, perhaps meeting up with the *Orient Express* train in Italy to fly passengers home.

The aircraft has to be flown by a traditional pilot-copilot-flight engineer crew. Though DC-6 has hydraulics for operating systems like brakes and landing gear, its flying controls are completely manual. Firth, who has flown it for 14 years, says the airplane is easy to fly and “an absolute joy.” The cleanup didn’t change her classic handling a bit. “She’s the same plane underneath,” he says, “and for me that’s the great thing.” —







# Travels with Churchill

**WHY THE BRITISH PRIME MINISTER FLEW WARTIME ROUNDS IN A YANK BOMBER WITH AN AMERICAN PILOT.**

by Graham Chandler

**WINSTON CHURCHILL** was anxious to leave the country. It was July 1942, and he wanted to go to Cairo and Moscow to confer with his generals and with Soviet leader Josef Stalin, but the pilot assigned to fly him urged caution. "I'd like...a bad night to get out of England to go to Gibraltar," William J. Vanderkloot told the British prime minister. Years later, he explained to his son, Bill, "I didn't want to get shot down over England."

Vanderkloot was recounting, in a taped interview with his son, how he came to be the captain of a B-24 Liberator bomber that had been turned into a VIP transport. "Mr. Churchill said, 'Go ahead, pick your night,'" Vanderkloot recalled. "I can give you a 10-day envelope.'" The long-range Liberator, painted black in an early attempt at stealth, flying at night, with no one but the crew knowing the flight plan, was considered the safest bet to transport a prime minister on a route that was with-

in range of enemy fighters.

In the late summer of 1942, Churchill was faced with critical decisions, notably what to do about weaknesses in the leadership of the British Eighth Army, which was facing Field Marshal Erwin Rommel's formidable Afrika Korps, as well as how to persuade Stalin to reinforce Europe's eastern front. "It had become urgently necessary for me to go there and settle the decisive questions on the spot," Churchill wrote in *The Second World War*. But such a trip would have ordinarily involved six days of flying and several nasty inoculations. "However," he continued, "there ar-

rived at the Air Ministry a young American pilot, Captain Vanderkloot, who had just flown from the United States in the aeroplane 'Commando,' a Liberator plane from which the bomb-racks had been removed and some sort of passenger accommodation substituted.... I could be in Cairo in two days without any trouble about Central African bugs..."

Vanderkloot had been flying U.S.-built bombers across the north Atlantic, known for its deadly weather, for the Royal Air Force's Ferry Command for some 18 months and had logged over a million miles, occasionally carrying VIPs to exotic sites.

**Winston Churchill and an anxious young soldier scan the sky. In 1942 England, aircraft often didn't return. Churchill, though, felt safe enough in the sturdy B-24 (inset) that served as his personal transport. Right: Crew members Russ Holmes, Jack Ruggles, William Vanderkloot, Ron Williams, and John Affleck (left to right) stealthily flew Churchill and other VIPs to crucial meetings around the globe.**







IMPERIAL WAR MUSEUM

**Military aircraft lack the amenities – like boarding stairs and passenger seats – of their civilian counterparts. Churchill coped, but often took the copilot's seat.**

Such credentials, along with renowned navigation skills, brought him to the attention of Air Chief Marshal Sir Charles Portal, responsible for transporting Churchill through Africa. When Portal asked Vanderkloot how he would fly to Cairo, the Ferry Command pilot told him: "Certainly not through the Mediterranean with the Germans flanking both sides," and suggested a route with a single stopover in Gibraltar. Portal hired him on the spot, and Vanderkloot chose the B-24. "That was some airplane, the Liberator," Vanderkloot later said. "Nicely built."

*Commando* got under way. In Cairo, Churchill eventually replaced Eighth Army General John Eyre Auchinleck with Lieutenant General Bernard Montgomery. On October 24, the Associated Press reported, "Britain's rebuilt and refreshed 8th Army charged into the Axis' El Alamein line today in...what may be the battle to decide the fate of the Mediterranean this winter." Liberators were part of the action. The September 3, 1942 issue of Britain's *Flight* magazine ran the headline "Liberators over Egypt: Anglicized Heavies in Western Desert." In Moscow, Churchill met with Averell Harriman, representing the United States, and Stalin to plan the North African campaign.

Churchill was enthralled with flight. He celebrated his 39th birthday by taking his first flying lesson. According to Churchill

biographer Martin Gilbert, when the prime minister's instructor was killed shortly afterward, Churchill's wife and family expressed their sentiments about his taking up a pastime "fraught with so much danger to life," as his cousin, Sunny Charles, ninth Duke of Marlborough, put it. "It is really wrong of you," the duke continued. After takeoff at London's Croydon airport, Churchill stalled his trainer in a tight turn, plowing into the ground and injuring his instructor. He vowed never to fly as a pilot again.

But he still enjoyed air travel. "He used to like to come up [to the cockpit]," Vanderkloot said. "He'd stay maybe an hour, and he'd ask questions about things. He was a good old sport, he'd have his scotch up there and look around."

*Commando* was usually flown by Vanderkloot and another American, copilot Jack Ruggles. Flight engineers John Affleck and Ronnie Williams and radio officer Russ Holmes were Canadian. Today, Affleck is the only surviving crew member. He joined Vanderkloot on the first run with Churchill in August 1942. At the time, the young civilian flight engineer and racing car enthusiast was in West Palm Beach, Florida, fresh off a Liberator that had flown ammunition to Africa for the Eighth Army. "You didn't have to be in the military to do that—they'd take anybody," says Affleck. When asked if he would go to Cairo that night, he said, "Sure, I always wanted to see Cairo."

At 93, Affleck still walks nine holes at the Saskatoon Golf & Country Club. Relaxing at his home in Saskatchewan in kha-

ki chinos and a golf shirt, he remembered that night in 1942. "So they said, 'Get the car, get some clothes, and come back.' I was on the way to Prestwick [Scotland] that night."

From Prestwick they flew to Lyneham Royal Air Force base and on to London. "And there is where we learned we were to fly Churchill out to Cairo and Moscow," says Affleck. It was also there that he learned he was to fly with the legendary William J. Vanderkloot. "I didn't know him well because our paths hadn't crossed," says Affleck, "but I knew he was a good pilot—in fact an excellent, super pilot. And a super navigator too."

In the days of navigation by maps and checkpoints, Vanderkloot's skills were critical. "It was obvious that if you were really going to stay alive, you better know how to use celestial navigation," Vanderkloot told his son. During much of his time in England, he had worked on perfecting the art, learning it from RAF navigation officer Bill White, "someone [who] really knew it." Vanderkloot and a handful of other aspiring celestial navigators would spend night after night on London's rooftops practicing with the sextant. "Be it summer, winter, rain or whatever, we'd take our shots, then go downstairs and plot them," said Vanderkloot. "We learned celestial navigation in a hurry. It sure put me in good stead for later on."

Indeed, Vanderkloot did nearly all of his own navigating. It was unusual for a pilot, "but...I figured if I'm going to get in trouble, I'm going to do it [myself]. I'm not going to have some other guy do it."

When Affleck arrived in London and met Vanderkloot, they learned they were to fly a newly modified B-24 Liberator, number AL504, nicknamed *Commando*. "The bomb bays were sealed, of course," said Vanderkloot. "The bomb racks were taken out and...kind of a half-baked cabin was put inside. We had no windows, so it was dark. The only place where it was light was up on the flight deck, where you had windows on the side and the front. So the poor passengers sat in the back, [in] four rows of single seats." Up under the wing, with the big gas tanks, was a sort of berth about the size of two king-size mattresses where



Churchill could sleep. "The other fellows had to sleep in their chairs," Vanderkloot recalled. "His doctor sat in one seat. Sawyer [his valet] sat in the other." There were maybe 15 people on the flights, including many admirals and generals. "Churchill had his ADC [aide de camp], who was Commander Thompson. There was the man from the CID [the Criminal Investigation Department of Scotland Yard], and always some other ministers with him."

Transporting VIPs over dangerous territory didn't faze Affleck. "Some people said later, 'Aren't you feeling a lot of responsibility?' I said 'No, I'm going to get there; so as long as they stay with me, they're all right.' It didn't bother me who [Churchill] was. I never was impressed by ranks, or by who they were. I always looked at them and thought they do the same things as I do."

"I can't say that I admired [Churchill],

other than for what he was as a person. He was a great actor, he was a great egotist; oh, his ego was as big as a mile."

Affleck says Churchill didn't interact much with the crew. "We were only lowly mechanics." But, he says, the prime minister talked to Vanderkloot, whom he greatly respected.

slippers and dressing gown and he'd come up and ask, 'Where are we?' Then he would go back to bed," says Affleck. "We had like a camp stove, and they would prepare nice sandwiches—that kind of thing."

Affleck came to prefer the company of other passengers. "The nicest guys were [British politician] Anthony Eden, [Chief

.....

**Churchill's wife and family expressed their sentiments about his taking up a pastime "fraught with so much danger to life." After takeoff at London's Croydon airport, Churchill stalled his trainer in a tight turn, plowing into the ground and injuring his instructor. He vowed never to fly as a pilot again.**

He remembers Churchill's vices: "He liked to drink. And always, he wanted his cigar. Fortunately, you could open a small blister window right beside each of the pilot's seats and it would vent, so you could keep the smoke out."

As they normally flew in darkness, "[Churchill] would have his pajamas and

of Combined Operations] Lord Louis Mountbatten, and all the generals," he says. On occasion the aircrew themselves were treated like VIPs. "When Lord Louis was head of Southeast Asia Command, we stayed at his summer palace in New Delhi," Affleck says. "And he had the whole crew down for dinner—all the top-brass Americans and Brits—at the same table."

The crew always had to be wary of enemy eyes. The Allies "were a little apprehensive in Cairo because the Germans were only 75 miles away," recalls Affleck. Despite the best efforts to maintain secrecy, he says, the Germans seemed to know where they were. When *Commando* first got to Cairo, RAF photographers "took a picture of the airplane. It had '504' on the side, but they blanked out the number" on the copies the photographers gave to the crew members. "But when we left Cairo and went to Moscow, there was the headline in the [Cairo English-language] paper, 'Churchill arrives in Cairo,' and a picture of the airplane with 'AL504' on it. We laughed a lot about that."

The Germans were desperate to shoot

**His medical advisors thought it unwise to subject Churchill to high-altitude flight in an unpressurized aircraft, so they came up with the "Churchill Egg," which could ensconce the prime minister in close-to-sea-level pressure. Though less than robust, Churchill never used it.**



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ASSOCIATED PRESS

**Churchill's first flight in *Commando*, in August 1942, deposited him in Cairo, Egypt, where he replaced the British Eighth Army's General J.E. Auchinleck (right) with General Bernard Montgomery.**

down Churchill's aircraft. Affleck says the Germans "knew our takeoffs because Lord Haw Haw [nickname of German propaganda broadcasters] was saying that Churchill left so-and-so tonight. Somebody always knew something."

Just two of *Commando*'s excursions included Churchill and his retinue. "We flew him to Cairo, Moscow, and Turkey," says Affleck. "We also went to Morocco, Tunisia and Algeria, and Libya in 1943." A few improvements had been made for the later series of flights, including the addition of primitive heaters that Churchill thought a bit dangerous. They were turned off, prompting the cold-soaked prime minister to drape himself in blankets in strategic places. "The P.M. is at a disadvantage in this kind of travel, since he never wears anything at night but a silk vest," wrote his physician, Sir Charles Wilson, in his diaries. "On his hands and knees, he cut a quaint figure with his big, bare bottom."

When he flew with the prime minister, Affleck says he wasn't allowed to keep a logbook. "They didn't want anyone to know where we had been"—such as LG224, the code for RAF Cairo West—he says, showing me a yellowed carbon copy list of the airplane's flights, which he had obtained

.....  
**John Affleck remembers Churchill's vices: "He liked to drink. And always, he wanted his cigar. Fortunately, you could open a small blister window, so you could keep the smoke out."**

from Britain's Air Ministry after the information was declassified.

After the second extended trip, Churchill never again flew in *Commando*, instead switching to the York, a passenger version of the Lancaster bomber. In September 1943, Liberator AL504 was withdrawn from VIP service and flown to a Tucson, Arizona U.S. Air Force base, where it underwent major modifications and emerged as a one-off transport with single tail fin, extended fuselage, and upgraded engines. AL504 flew again in March 1944 as the trial ver-

sion of the U.S. Navy's RY-3 transport. Vanderkloot and the crew continued to fly it—Affleck's last logbook entry for AL504 is November 24, 1944.

In early spring the following year, with a new crew, *Commando* made its last trip: After taking off from the Azores, it was lost without a trace. Affleck remembers testifying at a Board of Inquiry. "The last message they got was—and it was the only message—there was an oil leak on number-two engine," he says. "No signal, no SOS. And there was nothing in the German records to say they had shot it down."

Affleck knows Liberators well, and suspects that the oil leak could have caused the crash. He says the Wasp engines normally never leaked. But "they had a big oil tank, and you only filled them about two-thirds full to allow for foaming. If you overfilled them it would push [oil] out." And hot oil burns. "It would soon put a hole in that bulkhead and then, BOOM, because that's where all the gas was."

During his service on *Commando*, Affleck was offered a commission in the Royal Air Force, but turned it down. "It was easier to get things done as a civilian," he says, "because you could talk directly to the generals without having to work your way up the chain of command."

Vanderkloot received the honorary Commander of the Order of the British Empire in November 1942. He occasionally used the ribbon to fasten panels in *Commando* to keep the sun off Churchill. *Commando*'s

crew members were recognized for their Royal Air Force Ferry Command service and their safe transport of wartime VIPs; Affleck also received a Member of the Order of the British Empire. In 1944 Vanderkloot wrote *Handbook of Air Navigation*, which a reviewer described as "literally tremendous in scope...an air-navigation encyclopedia." The following year, Vanderkloot returned to the United States and became a corporate pilot. For years, he and Churchill remained a mutual admiration society of two. —



A high-angle photograph of an astronaut in a white spacesuit with a gold helmet, emerging from a circular hatch in the white, riveted exterior of a space shuttle. The hatch is open, and the astronaut is positioned within the circular frame. The surrounding structure is covered in numerous small, dark rivets. In the upper left, a rectangular panel with a circular light is visible. In the upper right, a complex assembly of wires and equipment is seen through an opening.

# Step Outside

**HOW HUMANS LEARNED TO  
WALK IN SPACE.**

**BY TONY REICHHARDT**

In NASA jargon, it's called "egress" — the moment an astronaut leaves the hatch to begin a spacewalk (here, during shuttle mission STS-92 in 2000).



## 1965: Human Satellite

**FROM THE BEGINNING,** NASA knew astronauts would have to leave their spacecraft. They'd have to fix things outside, transfer between orbiting vehicles in an emergency, and—most ambitious of all—walk on the moon.

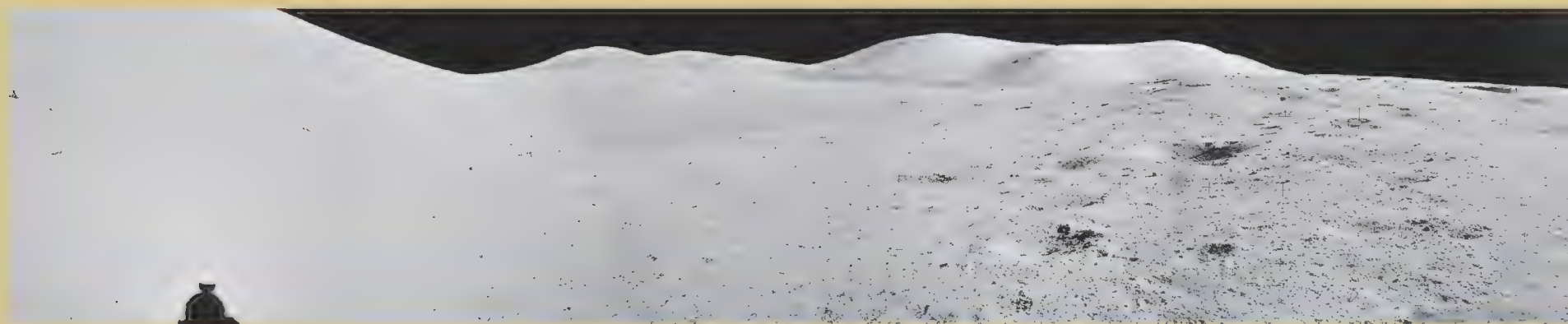
All the techniques of extravehicular activity (EVA) had to be invented and perfected beforehand—how to “ingress” and “egress” through hatches, then airlocks; how to pre-breathe oxygen to avoid the bends (which also afflicts divers); how to anchor yourself in weightlessness; and how to maintain a comfortable temperature in your spacesuit.

Today, with more than 300 spacewalks logged since Alexei Leonov's first, on Voskhod 2 in March 1965, orbiting construction workers clamber around a space station the size of a skyscraper with hardly a thought to their surroundings. What once seemed magical has become standard operating procedure.

**T**HE FIRST U.S. SPACEWALK, on Gemini 4 in June 1965, was surprisingly easy, almost playful at times. Mission control couldn't hear Ed White very well—there was a problem with his microphone. So crewmate Jim McDivitt narrated the action while White drift-



## 1972: The L



**M**OOONWALKING wasn't like spacewalking; it had its own rules and rhythms. When astronauts bounded across the lunar surface, it was important to keep the heavy backpack's momentum from getting away from them. The moonwalkers perfected a kind of loping run that worked

well in low gravity, and though they occasionally fell down, no one was seriously hurt. (Clowning around on Apollo 16, Charlie Duke jumped four feet off the ground and landed flat on his back. “It was the only time in our whole lunar stay that I had a real moment of panic,” he wrote years later.)





ed on his 25-foot tether and admired the view. When White planted his boots on the tiny spacecraft, McDivitt laughed, “You’re smearing up my windshield, you dirty dog.” White propelled himself with a little “zip gun” that fired compressed gas. He loved it—so much so that McDivitt had to badger him to come back inside. The whole thing lasted just 36 minutes.

Gemini 9, on the other hand, was nearly a disaster. Gene Cernan worked so hard trying to get into an Air Force-built jet backpack called the Astronaut Maneuvering Unit that the exertion made his helmet visor fog up, and he had to cut the spacewalk short. Problems with this and later Gemini EVAs sent NASA back to the drawing board to redesign the suit and hatch and make other fixes. By the time of Buzz Aldrin’s three Gemini 12 outings in November 1966, EVA had become a science. Many of the spacewalking procedures in use today were developed during the Gemini program.



## 1972: Way Out There

**T**HE “DEEP SPACE EVA” may be the rarest of astronaut experiences. Only three people have done it: Al Worden on Apollo 15, Ken Mattingly on Apollo 16, and Ron Evans on Apollo 17 (pictured). A third of the way back from the moon, they climbed outside the command/service module to retrieve film that couldn’t survive entry into Earth’s atmosphere. For about an hour, each of the astronauts floated in deep space, tethered to their craft, 170,000 miles from Earth. On his Apollo 16 outing, Mattingly was at first troubled by not being able to see stars; then he opened his visor and was reassured. Years later he told an interviewer that experiencing that utter blackness was the only time during the moon voyage that he felt far from home.

## Longest Walk



On the last three Apollo missions, the astronauts had a “moon buggy” that greatly extended their range and allowed much more ambitious geological fieldwork. In this photo, taken during the second Apollo 17 EVA in December 1972, Gene Cernan is more than five miles from his lunar lander—the farthest

an astronaut ever strayed from a spacecraft. If their rover had broken down, NASA estimated Cernan and Jack Schmitt had enough oxygen and cooling water to make it back to the lander, walking at an average speed of 1.7 mph, or about 50 yards a minute.





## 1984: Untethered

**IT WAS COLD OUT THERE.** All six space shuttle astronauts who flew the jet-powered backpack known as the Manned Maneuvering Unit (MMU) during their untethered spacewalks reported feeling chilled. Bruce McCandless (pictured here), who traveled farthest from the shuttle's warm cargo bay—320 feet—cranked his spacesuit to the full “hot” position and left it there.

The MMU cruised at three feet per second, propelled by blasts of nitrogen gas. It was fitting that

McCandless was the first to fly it, on the 1984 shuttle mission STS 41-B. He had helped develop a predecessor device tested inside the cavernous Skylab space station in the 1970s. The MMU gave a smooth ride, but ultimately it was a technology without a mission; astronauts were able to reach anywhere they needed by other means. The MMUs were retired in 1984 after just three flights, although a small backpack called SAFER is still used during spacewalks as a backup to tethers.

## 1985: Heavy Lifting



**EVEN THOUGH LARGE SATELLITES** are weightless in space, moving them around can be strenuous work. On STS-51-L in 1985, astronauts William Fisher and James van Hoften (pictured) repaired the 15,000-pound Leasat 3 satellite in the shuttle cargo bay. Then, van Hoften, nicknamed “Ox,” set the massive spacecraft spinning and released it with a shove into space.

Back on the ground, he told debriefers, “Trying to do a translation [linear motion] and a rotation at the same time is a very difficult task, and 15,000 pounds is seven and a half tons. It’s big.”



## 1998: The Champion

**F**OLLOWING THE FIRST spacewalk by the Soviet Union in 1965, NASA dominated the practice of EVA for a decade; 38 of the first 40 spacewalks were American. But once the Soviets began building space stations—first Salyut in the 1970s, then Mir, then the core modules of the International Space Station—cosmonauts began racking up EVA hours maintaining the orbiting outposts. Anatoly Solovyev, shown here outside Mir in 1998, remains the world champion spacewalker, with 16 EVAs totaling 82 hours.



## 1992: Three Men Out

**B**EFORE STS-49 in 1992, NASA had never sent three astronauts out on a spacewalk at the same time. It was the crew's idea. When the original plan to secure the crippled Intelsat VI satellite failed—Pierre Thuot had tried to capture it while standing on the end of the shuttle's robot arm—the crew improvised a scheme to send out Thuot, Rick Hieb, and Tom Akers to grab the slowly rotating satellite with their gloved hands. It worked. Then they attached a new rocket motor and sent the Intelsat on its way. Thuot said later, "Every time I watch the video from STS-49, I say, 'God, I can't believe we did that.'"







## 2006: Orbital Hardhats

**B**EFORE NASA started building the International Space Station in the late 1990s, agency engineers fretted publicly about the number of spacewalks that would be required to assemble the giant facility, which, when finished, will stretch 361 feet and weigh (if it were on Earth) 925,000 pounds. Critics thought the need for frequent, challenging EVAs could be a showstopper. Now, 123 successful spacewalks later, the astronauts

have made the most complex assembly project in space history seem almost easy.

The orbital construction workers have come from the United States, Russia, Europe, Japan, and Canada.

Here, NASA's Bob Curbeam (left) and Swedish astronaut Christer Fuglesang replace a camera on one of the station's truss segments during STS-116 in 2006. Below them is New Zealand's Cook Strait.

## 1997: Fixing Hubble

**W**ITHOUT SPACEWALKERS, the \$1.6 billion Hubble Space Telescope would be known today as just a costly embarrassment. After it was launched on STS-31 in 1990, NASA discovered a flaw in Hubble's mirror. Three years later, spacewalking astronauts installed a corrective optics system that restored the exquisite vision that has made the telescope one of the most productive scientific instruments in history.

Luckily, Hubble had been designed to be serviced by astronauts. The orbiting observatory has required four more space shuttle missions to change parts and install newer, more capable cameras (pic-

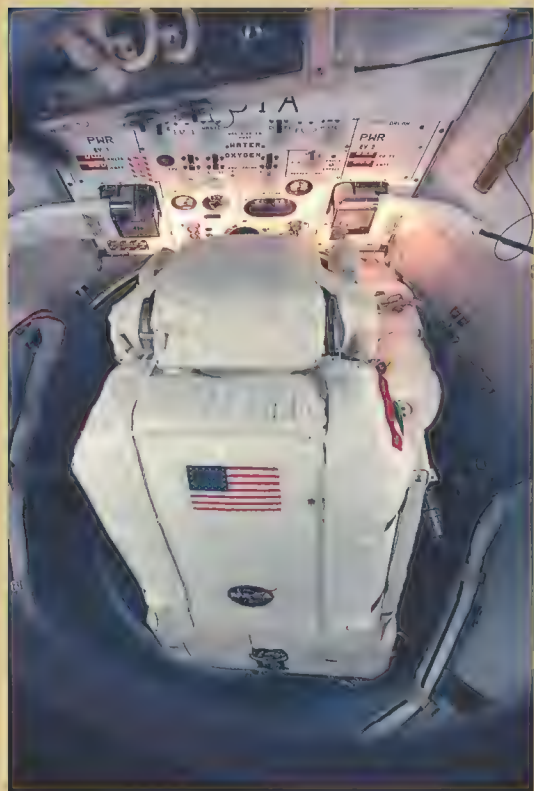
tured is Steve Smith on the second servicing mission, in 1997).





## 2007: Ready Room

**A**STRONAUT Rick Mastracchio prepares to exit the space station's Quest airlock to begin a spacewalk in August 2007. Airlocks serve as a buffer zone between a spacecraft's shirtsleeve environment and the vacuum of space. Before an EVA, space-suited astronauts go inside the sealed chamber, air is pumped out, and they open the hatch to step outside. When they come back in, the process is reversed: Air is pumped



back into the airlock before the spacewalkers open the inner hatch to rejoin their crewmates. Quest isn't the station's only airlock, but it's the most spacious—so roomy, in fact, that astronauts spend the night in it before a spacewalk to acclimate to lower air pressure, flush nitrogen from their blood, and reduce the time they need to breathe pure oxygen before going outside.

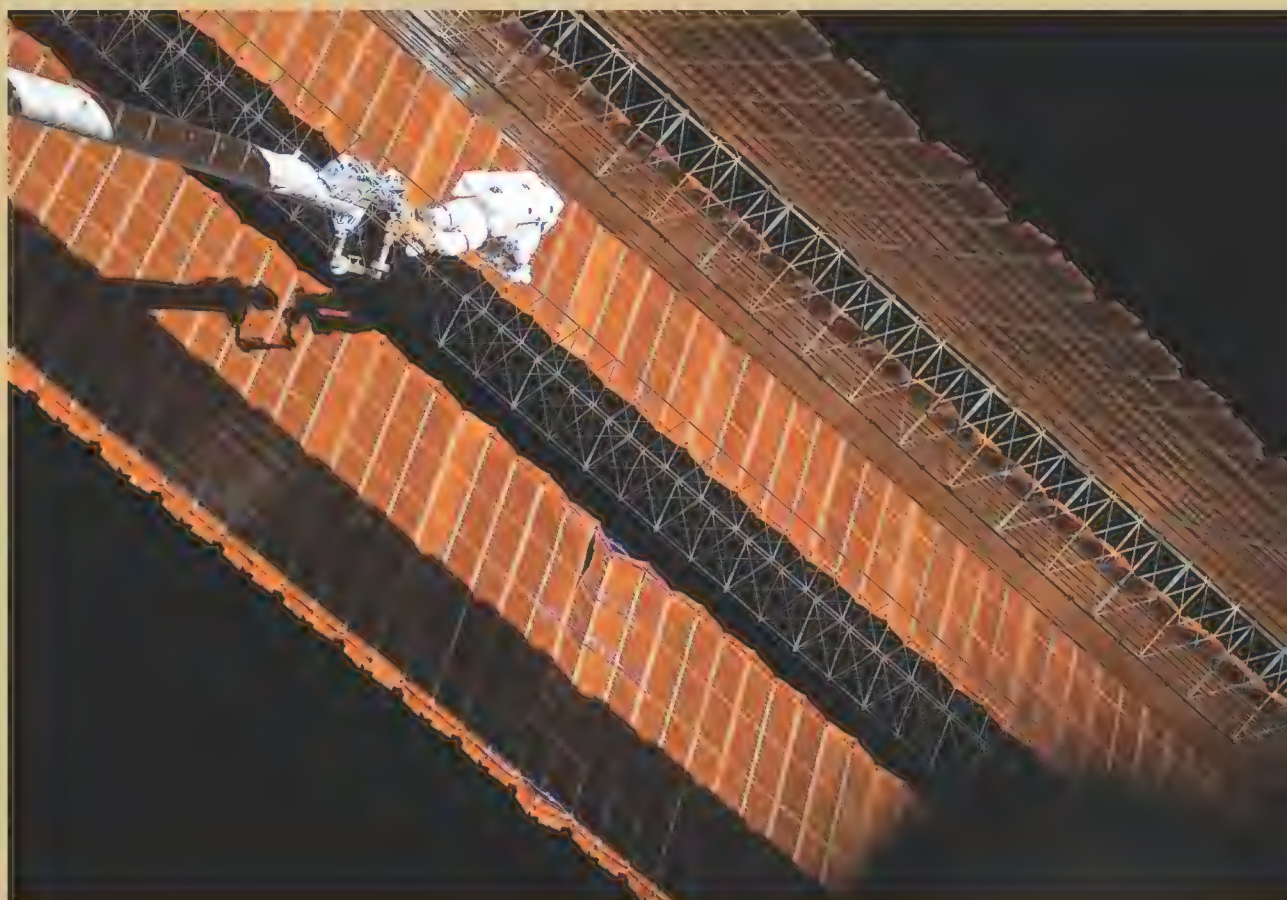


## 2005: Pool Practice

**T**HE SIX-MILLION-GALLON indoor pool at NASA's Johnson Space Center in Houston goes by a prosaic name: the Neutral Buoyancy Laboratory. Since the days of Gemini, astronauts have used underwater training to rehearse the intricate choreography of an EVA—where and how to move, in what sequence, and on what schedule. Typically, a spacewalker in training, like Bill McArthur (seen here preparing for a 2005 mission), will spend 14 hours underwater for every hour he spends on an actual EVA. By the time astronauts head out the airlock, they've repeated the task so many times it has become second nature.

## 2007: A Stretch

**S**PACEWALKERS do everything they can to minimize risk, but a certain amount of danger is unavoidable. On STS-120 in November 2007, a tear in the space station's wing-like solar array needed repairing, and veteran spacewalker Scott Parazynski was the right man for the job. The tear was at a remote location on the giant complex, and required that the six-foot-two Parazynski be hoisted to the very limit of a 50-foot-long extension held by the shuttle's 50-foot-long robot arm. A former surgeon, the astronaut made the repair while being careful to avoid electric shock and sharp metal that could tear his suit. Parazynski has an affinity for heights: Shortly after leaving NASA this spring, he set out to become the first astronaut to summit Mount Everest.







**WHEN I STARTED FLYING AIRSHOWS,**

back in 1971, the edge of the known aerobatic world was a maneuver known as the lomcevak. The great-granddaddy of tumbles, the lomcevak (pronounced “LAHM-sha-vock”) took you to a wild place, where one minute the air under your wing was solid as a fist, and the next you were toppling tailwheel over nose cone into the abyss, as out of control as

an unhinged car on a Ferris wheel.

Recently I watched aerobatic performer Greg Poe cartwheel his bright red Fagen MX-2 across the show line. A few beats later, the airplane began a tight, fast, vertical roll, which widened into a corkscrew and topped out around 2,000 feet. There it stayed, continuing to rotate, but now Frisbee-like, with its nose following the horizon. It hovered for a moment before

flat spinning downward. Poe had seamlessly blended four maneuvers into a single magic trick. His routine is only one of a dozen on the airshow circuit today that make me realize: Tumbles have changed.

Nobody knows exactly how many kinds of tumbles there are now. If we could tally all the differences in the maneuvers that depend on aircraft design, center of gravity, entry and exit attitudes, control





# Tumbling With the Stars

**THE NEWEST TWISTS ON AN OLD DANCE STEP, BY DEBBIE GARY**

Head games: Fierce concentration is what keeps airshow pilot Greg Poe from knocking his noggin during a low inverted pass. With equal focus, Poe and other aerobatic pilots control their aircraft even during the most chaotic tumbles.





### VERTICAL ROLL

Throughout a vertical roll, a standard airshow maneuver, the aircraft's nose points straight up. In a negative vertical snap roll, which Nicolay Timofeev's friends were flying, the nose would describe an upward spiral and the pilot would experience negative G, which would push him forward against his seat belts.

movements that change during the maneuvers, and the amount of experience and recent practice pilots have, the number would be overwhelming. Some show pilots have created—and named—signature tumbles. One of the most famous is Sean Tucker's Centrifuge. Tucker's Oracle Challenger Pitts leaps across the sky from tumble to tumble. Its nose twists over its right shoulder toward its tail 7, 8, 9 times—as if snarling at a demon behind it—10, 11, 12 times.

All the various tumbles have one thing in common: Pilots get into them by using the gyroscopic effect of a spinning propeller. Pushing on a spinning gyro moves it 90 degrees to the left or right of the direction the push came from. A pilot starts a roll, and, with the help of the propeller's gyroscopic forces, skids the nose to point at an angle from the line of forward motion (see "Shoulder Roll," opposite). The airplane behaves like a car going downhill fast, skidding sideways, then rolling over.

When the only game in town was the lomcevak, we entered the tumble in climbing roll, pushed the ailerons on our wings one way and the rudder on our tail the other way, then just hung on until the airplane spit us out into an inverted spin. The airplanes responded differently. For instance, my Pitts would tumble slightly cock-eyed, tail over wing, whereas Art Scholl's Super Chipmunk would tumble forward, tail following nose as if the airplane were inside a squirrel cage. But we called them all lomcevaks—a Czech word for either a headache, a hangover, or a big slug of plum brandy; we'd heard all these translations.

We did them on purpose, of course, but three-time world aerobatic pilot Nikolay Timofeev says that Czech pilot Ladislav Bezak probably discovered the first one in his Zlin by accident, the way Soviet pilots discovered some of their tumbling maneuvers around 1976. "As soon as we receive Yak 50 we start to do negative snaps on vertical line," he says (see "Vertical Roll," left). "And we jump into gyroscopic inertia rotation because Yak 50 is not really good airplane for negative snaps, especially on vertical up lines. I believe same story in Czech Republic. Zlin 50 is also not excellent for negative snap on way up."

Mistakes can be turned into maneuvers if pilots can figure out what they did in the first place. Former U.S. national aer-



TYSON RININGER

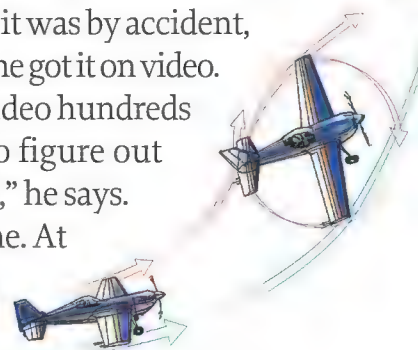
**Aerobatic champ Michael Goulian lets his fingers do the tumbling – in a typical show pilot rehearsal – before climbing into his Extra 300SHP (opposite), powered by a Lycoming Thunderbolt engine.**

obatic champion David Martin has perfected a forward tumble that is so straight and so tightly flown that it looks as if his CAP 232 is swinging by its tailwheel from a high wire. He has spent thousands of hours practicing aerobatics, particularly his tumbles.

"If you are talking something new that you want to do in an airshow," he says, "you have to figure out how to do it; then you have to figure out how to consistently do it; then you've got to figure out doing it at a lower altitude. It takes a while. I practice purposely messing them up. Because if I am going to be doing them at low altitude, I need to know what is going to happen. So that is a lot of practice."

The first time he did the one he calls the Good Tumble it was by accident, but luckily someone got it on video. "I looked at that video hundreds of times, trying to figure out exactly what I did," he says. "It took a long time. At first, even after I figured out how to do it, I might get it 50 percent of the time, then it would be 75 percent, then finally I've got it now where it is. I won't say it is 100 percent, but at least 90 percent of the time it will do what I want it to do."

"The thing I learned about tumbling







maneuvers is that nobody is very good at telling you how to do it. You've got to kind of figure it out on your own."

Debby Rihn-Harvey, the current national aerobatic champion, says that when airshow fans ask about tumbles, pilots are cautious about what they share, because tumbles are potentially dangerous. "Every airplane is going to

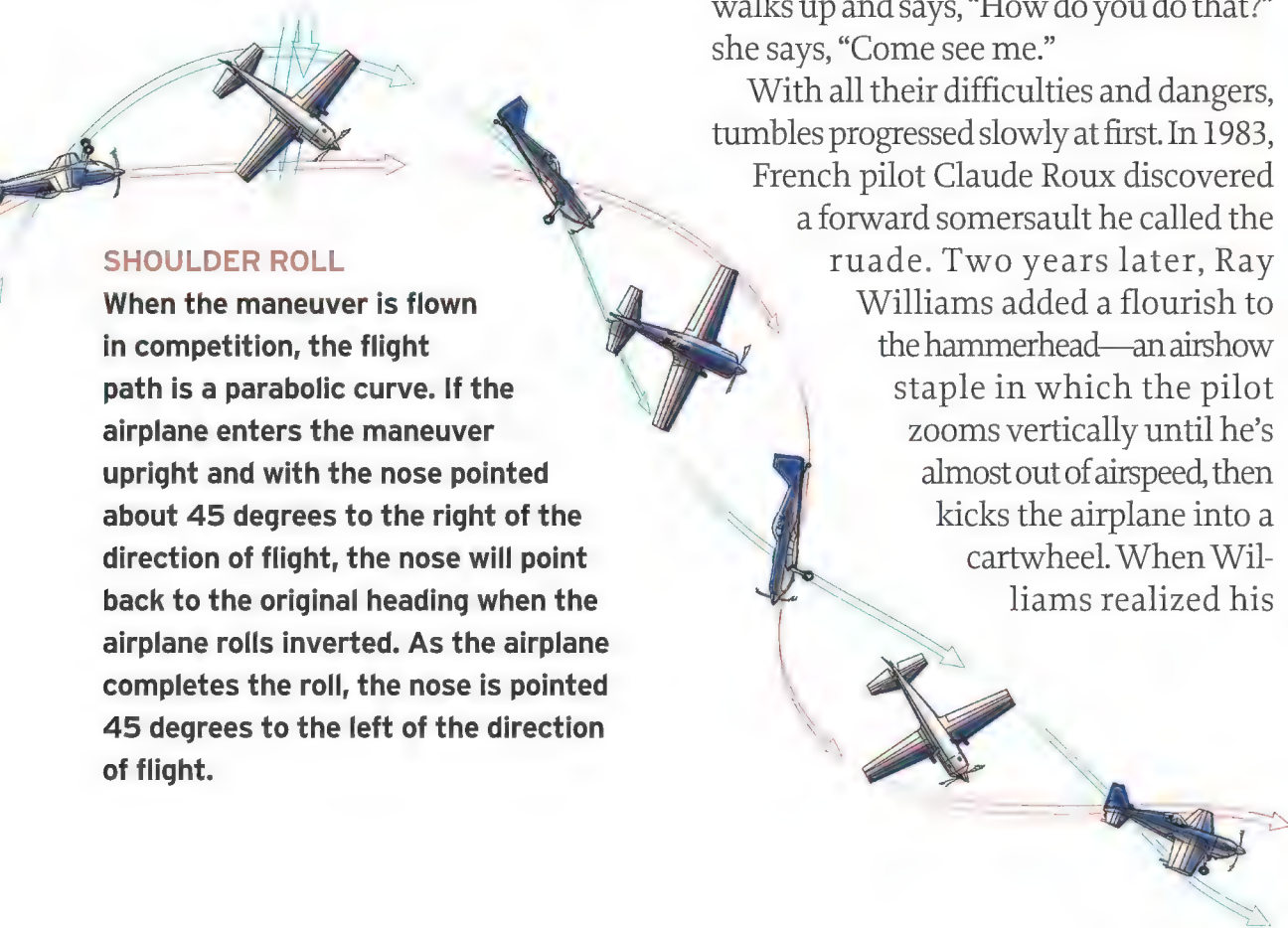
be a little bit different," she says.

Rihn-Harvey flies a CAP 232 she calls the Hurricane II. Her show routine includes about six types of tumbles that she flies with competition-style precision and a touch of Texas yeehaw. When she's not flying shows, Rihn-Harvey is an airline pilot and has her own flight school: H&R Aviation, in La Porte, Texas; if a stranger walks up and says, "How do you do that?" she says, "Come see me."

With all their difficulties and dangers, tumbles progressed slowly at first. In 1983, French pilot Claude Roux discovered a forward somersault he called the ruade. Two years later, Ray Williams added a flourish to the hammerhead—an airshow staple in which the pilot zooms vertically until he's almost out of airspeed, then kicks the airplane into a cartwheel. When Williams realized his

#### SHOULDER ROLL

When the maneuver is flown in competition, the flight path is a parabolic curve. If the airplane enters the maneuver upright and with the nose pointed about 45 degrees to the right of the direction of flight, the nose will point back to the original heading when the airplane rolls inverted. As the airplane completes the roll, the nose is pointed 45 degrees to the left of the direction of flight.



During his 2005 retirement performance, tumbling pioneer Wayne Handley snap rolls his Raven. Handley also holds the record for inverted spins: 78.

Pitts S-2S could be coaxed into doing not just one but two pivots at the top of the hammerhead, he christened the new maneuver "whifferdill." In 1988, world aerobatic champion Henry Haigh brought us the knife-edge spin (see illustration, p. 45).

Other people were experimenting too, but the main reason gyroscopic maneuvers developed slowly and sporadically

LEFT: TYSON RININGER; TOP: ERIK HILDEBRANDT

ALL ILLUSTRATIONS BY HARRY WHITVER





TYSON RININGER



DAVID CARLSON

was that they broke airplanes. Their snapping entries produced sudden, jolting side loads on the airframe, the engine mounts, the tail sections, and especially the engine crankshafts. The metal propeller blades actually helped tumble the airplanes, but their weight also strained crankshafts and broke more than a few.

These dangers made most of us limit ourselves to one lomcevak per airshow; however, nothing slowed down future superstars Sean Tucker and Wayne Handley. On his way to discovering new ways to tumble airplanes, Tucker lost a propeller and broke nine crankshafts.

From 1984 through 1986, while both made a living as cropdusters, Tucker and Handley pursued their passion for tumbling maneuvers: practicing, critiquing, and egging each other on to try new things. "Wayne is an incredible innovator and thinker, a student of it," Tucker says. "But I clearly hold the record for broken crankshafts."

Airshow legend Gene Soucy recalls seeing the two fly for the first time, at Salinas, California. "I just stood there with my mouth open," he says. "They were flying the little Pitts, just like I had flown for 15 years, and were doing things I had never imagined. Here I was three-time national champion and my buddies were world team members. Even Leo [Loudenslager] was flying his ultimate airplane, and all we ever did was that one lomcevak. But all of a sudden you see these guys doing it on vertical lines, and doing the shoulder roll, like Sean's Centrifuge, eight different ways, eight different new maneuvers in that one show I watched that day. I just didn't believe it. Wayne Handley and Sean created that whole thing."

Tucker and Handley could not have maintained this quest had builders and manufacturers not significantly changed the designs of propellers, engines, and airframes. A lightweight, composite, three-blade propeller and a solid crankshaft flange ended Tucker's train of crankshaft mishaps.

Around the early 1990s, many aerobatic performers shifted from biplanes to monoplanes, and that migration set off another radical change. When aggressive

**An upward spiral is one of Sean Tucker's gentler maneuvers. Famous for inventiveness, Tucker has a new act: flying formation with his son (above, at right).**



**Debby Rihn-Harvey's CAP 232 is one of today's aerobatic marvels with carbon-fiber wings. Rihn-Harvey's other airplane is a 737; she flies for Southwest Airlines.**

flying led to cracks in wooden wings, the solution was to make wings of composites—carbon fiber layers over lightweight, honeycomb cores. “Once they switched to the composite material, assuming the wing is laid up properly, they were just almost indestructible wings,” Greg Poe says. “And so then, once you get to that point, then you become comfortable and it is now a matter of your imagination, how you can tweak a maneuver, how you present it to the crowd. Now the airplane is no longer the weak link.”

With airplanes they could trust, pilots flew as hard as they wanted, and creativity blossomed. Three-time national aerobatic champion Patty Wagstaff, who flies a Cirrus-sponsored Extra 300S, points out that the inspiration for some of the new maneuvers came from unusual sources. “The knife-edge spin was a really interesting maneuver that came from the [radio control] modelers,” she says, “and Henry Haigh started doing it in competitions.”

Some aerobatic pilots found ways to manipulate their airplanes to mimic the true tumble, to fly them all the way through the gyroscopically assisted maneuver so they are in control, rather than just along for the ride. In his routine, Michael Goulian, the 1995 national aerobatic champ, does nine tumbles that are like perfectly choreographed dance steps, timed to a music soundtrack. “When I do a tumble,” he says, “the attitude and the direction of exit is absolutely predetermined every single time. In other words, I am doing the same tumble, with the same entry and the same exit, every time. It is a matter of spending hours and hours of learning how to do them.”

“In a tumble you are always evaluating the attitude with which the plane is tumbling. Has it translated 90 degrees? How much energy is in the tumble? Am I going to do three rotations or four? In a tumble, you are thinking it through. You are not along for the ride. I will actually modulate the throttle and the rudder and the ailerons to fix a tumble that has gone bad...or to make it better, to make it flip one more time.”

I’ve watched him at shows: He pitch-

SCOTT SLOCUM



es his Extra 300SHP forward at the top of a loop, yaws it sideways, and shows us the airplane tumbling from left to right while its nose peeks sideways at us. Then when it looks as if the airplane will rotate one more time, he stops mid-tumble, just because he can.

Sean Tucker also taught himself to control the aircraft from the start of the tumble to the finish. “What I really focused on was how to fly the machine so I could do 9, 10, 11, 12 of them in a row across the sky,” he says. “It is not that difficult to do one of them, but to sustain one more than four or five times really takes finesse. It takes touch.”

Although they look wild, tumbles are not necessarily violent. “They have grown more aggressive and the perception is that



#### **KNIFE-EDGE SPIN**

**Imagine an airplane with its right wing pointed at the ground and its left at the sky. As the plane rotates, the right, or lower, wing will describe a smaller radius than the left. Its smoke trail will spiral like a telephone cord.**

they are out of control,” Tucker says. “Planes aren’t falling out of the sky and wings aren’t breaking off anymore, so they can’t be more violent. They are more dynamic, and that leads to the perception that they are more extreme. A nose-over-tail tumble is a zero-G maneuver. It is not violent. A centrifuge at high speeds will hurt you, though. It is 7 to 8 negative Gs. And a Bill Stein knife-edge spin is a lot of Gs.”

The best tumbling pilots practice relentlessly. “If you don’t practice them hundreds and hundreds of times,” Tucker says, “they will kill you at airshow altitudes. It all depends on what your altitude is. You always have to have your margins.”

It is not just the tumble a pilot has to prepare for, but also the spin that naturally follows a tumble. Japanese airshow pilot Rock Iwasaki was killed during a practice in 2005 while spinning out of a low-altitude tumble.

Tucker says, “I know that at 1,000 feet I can get out of an inverted flat spin, pull down and miss the ground, and still have energy. So any gyroscopic maneuver that I do, that I know has the potential to go into an inverted flat spin, always tops out at 1,000 feet above the ground, never at 800, even though you can do it all the time.”

At any altitude, performers flying tumbles thrill airshow crowds. Whenever I watch their routines, I remember a sticker Patty Wagstaff once had on the back of her Extra. “We’re professionals,” it said. “Don’t try this at home.” —



# *The* BILLY MITCHELL Court-Martial

COURTROOM SKETCHES FROM WHAT WAS, FOR AVIATORS,  
THE TRIAL OF THE CENTURY. by REBECCA MAKSEL



"I am here to tell the truth," Colonel Billy Mitchell (inset) told  
cheering American Legionnaires upon his arrival in Washington, D.C.



**ON OCTOBER 28, 1925**, a young legal aide reported to a ramshackle warehouse at the foot of the Capitol building in Washington, D.C. He placed a stack of legal volumes on a scarred wooden table, then waited for the court-martial of Army Air Service Colonel William "Billy" Mitchell to begin. William H. Webb was fresh out of law school when chief counsel Frank Reid asked him to join the defense team. Barely mentioned in the hundreds of newspaper accounts of the trial, Webb nonetheless impressed a reporter at the Baltimore *Evening Sun*, who wrote: "[This] wizard of legal research...cannot be seen as he sits hunched behind a big pillar in the courtroom, and as he seldom even whispers, his

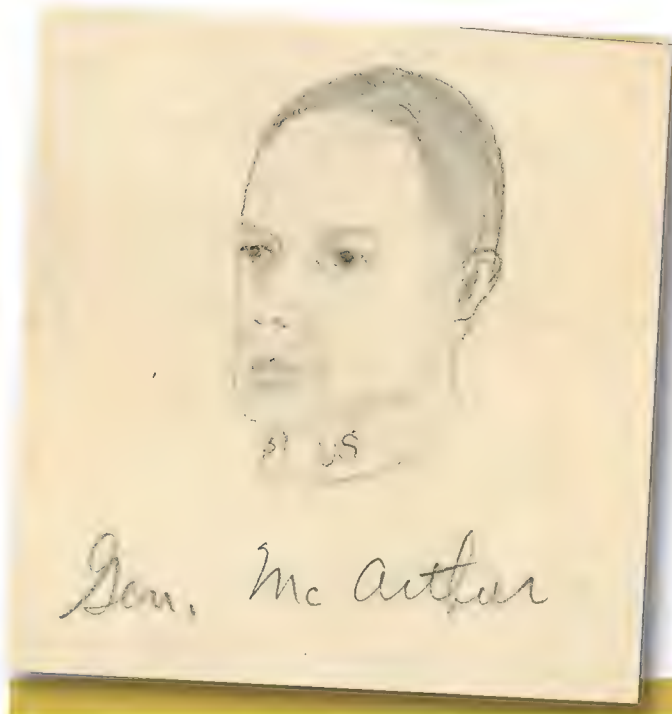


#### **WILL ROGERS**

The humorist accompanied Mitchell on his last flight as brigadier general before his pre-trial demotion. Mitchell, flying a de Havilland DH-4, offered to point out the sights. Rogers wrote, "I have always heard when you are up on anything high, don't look down; look up. So all I saw was the sky. The trip from a sightseeing point of view was a total loss to me.... [Mitchell] asked me if I saw the Mayflower, the President's private tug. How was I going to see it unless it was flying over us?"

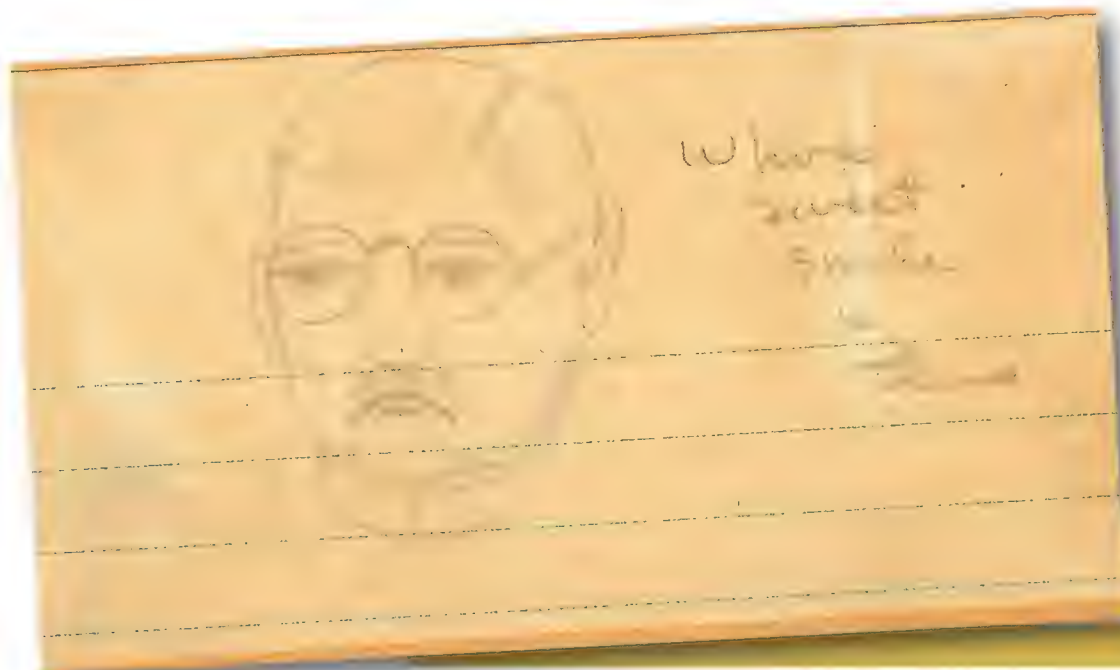
presence is unnoticed by spectators; and yet, besides Representative Reid, chief counsel, he is probably the most important personage among the Mitchell warriors at the court-martial.... He is the pivot of the defense, and it was his nimble fingers that thumbed the thick legal volumes that Reid quotes so glibly."

Recognizing the significance of the trial, young Webb compiled scrapbooks of material about his experience: photographs, newspaper clippings, and courtroom sketches made by an unidentified artist. There's Major General Douglas MacArthur, looking impossibly young; a frowning Major General William Graves, who fought Communists in Siberia; even a drawing of American humorist Will Rogers, who attended the trial to support the defendant. (Mitchell had given Rogers his first airplane ride, and the two had become friends.) William Webb Jr. remembers his father talking about the court-martial for years afterward. "We would look at the scrapbooks and he would give us a general overview of the trial and the people involved in it." Webb Jr. donated the collection to the National Air and Space Museum in 1992, seven years after his father's death. "I just thought that would be the place to put it," he says. "Anybody



#### **DOUGLAS MACARTHUR**

The major general and Mitchell were childhood friends. In *A Question of Loyalty*, a history of the court-martial, Douglas Waller writes that "Mitchell never liked to play with MacArthur when the parents got the two boys together because Mitchell thought MacArthur was a sissy."



#### **WILLIAM GRAVES**

The major general, a member of the court, commanded the Army's Sixth Corps, headquartered in Chicago. When one of his men testified that the War Department was loath to pay the \$1 per year rental for an airfield there, "General Graves's face was a study," reported the *New York Times*. "He lost no time in taking the witness in hand."



## WILLIAM WEBB

was described by the *Baltimore Evening Sun* as "a studious youngster with a quick wit and a boyish smile." Webb told the reporter he was proud of two things: "My work on the revision of laws, and...my participation in the Mitchell court-martial." His scrapbooks are in the National Air and Space Museum's archives.



who had an interest in the trial could come and look at the pictures, the newspaper articles, and so forth."

How his father came by the sketches is a mystery. Webb Jr. doesn't know who drew them, but thinks the artist may have been a woman. "My father was trying to capture as much as he could about the trial, and I think he felt the drawings added a little something to the scrapbook itself, so that's why he put them in," he says. Sketched by someone in the courtroom as the trial proceeded, the drawings are intimate snapshots of the participants. They have never been published, and have been seen only by those few who have researched the Museum's Mitchell collection.

The popular Colonel Mitchell was facing a court-martial for his controversial remarks to the press on September 5, blasting two military disasters: a bungled flight during which three Navy seaplanes failed to make it from the West Coast to Hawaii; and the



crash of the Navy airship USS *Shenandoah* while flying over the Midwest on an ill-advised public relations tour. "These incidents are the direct result of the incompetency, criminal negligence and almost treasonable administration of the national defense by the Navy and War Departments," Mitchell stated. "The bodies of my former companions in the air moulder under the soil in America, and Asia, Europe and Africa, many, yes a great many, sent there directly by official stupidity."

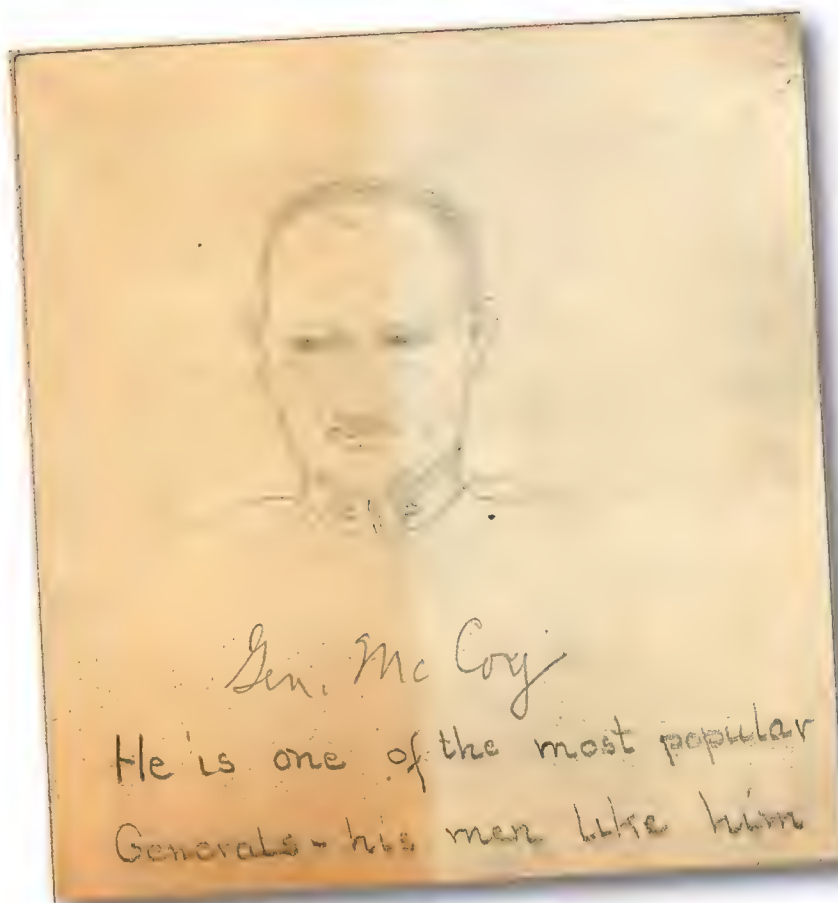
Within days, the War Department charged Mitchell with violating the Ninety-sixth Article of War, which covered "all conduct of a nature to bring discredit upon the military service."

At the court-martial, Reid—who took the case for free, hoping it would make him a national figure—argued that Mitchell's Constitutional right to free speech trumped his duties as an officer. Reid praised his client's warnings as patriotic, concluding with a flourish, "Rome endured as long as there were Romans; America will endure as long as there are Mitchells."

The prosecution, however, argued that in the military, free speech would lead to chaos. Claimed the trial judge advocate: "A private can berate his captain before his company, the captain can criticize and ridicule his major before his battalion and the major can lampoon his colonel.... Discipline and control under such a view of law would vanish and the Army become a mob."

## FRANK MCCOY

Mitchell believed the brigadier general to be his ally on the jury. McCoy was fond of Mitchell and was godparent to one of his children. "Billy Mitchell has stirred up more agitation than anybody since war time," he wrote to a friend in 1925. After Mitchell's death in 1936, McCoy honored his comrade one last time as a pallbearer.







**"Efforts to keep down our air power were begun as soon as the sound of the cannon had ceased on the Western Front in 1919," said Mitchell (second from right).**

The trial was front-page news. Each morning, nearly 500 spectators lined up outside the warehouse hoping for one of the few courtroom seats reserved for the public. Society matrons, reported the *Los Angeles Times*, were dismayed at their reception. "Luxuriously equipped limousines drew up along the curbing. Uniformed footmen jumped to open the doors and assist the occupants to the pavement.... The prominent as well as the socially unknown were told in regular doughboy fashion to 'fall in' line and await their turn to be admitted."

Public opinion was for Mitchell, a dashing war hero and unreserved advocate of air power, and stacks of letters poured in. (Mitchell's wife, Betty, would answer them during courtroom breaks.) Near Thanksgiving a group of Texas cowboys sent a live turkey for the colonel's holiday dinner and, reported the *Washington Herald*, offered their services: "If the bunch of us could do any good by standing back of you with Winchesters while you are telling the court about the negligence in the Air Service, we would like to be called as witnesses or guards."

But the public's enthusiasm did little good. The defense called 41 witnesses in an attempt to prove that by speaking out, Mitchell hoped to correct the Air Service's problems. The prosecution, on the other hand, didn't care if Mitchell's remarks were truthful



or not. They were trying him for insubordination. Because of Mitchell's high profile and public support, the generals let the defense present its evidence. But their view of Mitchell didn't change.

In his concluding remarks, Major Allen Gullion, the judge advocate, took a swipe at Mitchell: "Is such a man a safe guide? Is he a constructive person or is he a loose talking imaginative megalomaniac?... Is this man a Moses, fitted to lead the people out of a wilderness?... Is he not rather the all too familiar charlatan and demagogue type...and except for a decided difference in poise and mental powers in Burr's favor, like Aaron Burr?"

After more than seven weeks of testimony and 99 witnesses, the court-martial came to a close. In a secret ballot, the court sentenced Mitchell to a suspension from rank, command, and duty, with forfeiture of all pay for five years. "The Court is thus lenient because of the military record of the Accused during the World War," the generals wrote.

Unwilling to accept the verdict, Mitchell resigned as an officer in the U.S. Army on February 1, 1926. ➤

**FRANK REID**  
The chief counsel wore the same mouse-colored suit and wine-colored bow tie every day of the trial. "The perennality of the tie," reported the *Washington Star*, "is prejudicial to the good order of a well dressed man." When encouraged to try a little variety, Reid demurred, saying, "If I put on a new tie, somebody would accuse me of taking a fee."



# FIRE HAZARD

HOW DO YOU TRAIN AIRPORT FIREFIGHTERS WITHOUT POISONING THE AIRPORT?

BY SAM GOLDBERG

**FOR MOST AIRPORT FIREFIGHTERS,** the gritty, grueling kind of work—the kind they love—comes just once a year, courtesy of the Federal Aviation Administration. On those days, firefighters can ditch the weight training schedule, shrug off a zillion disaster management PowerPoints, and get to the good stuff: turning an actual hose against an actual flame.

The FAA requires all airport firefighters to train in at least one “live fire” exercise every 12 months. But even those rare training days have been affected by environmental regulations. Government agencies at all levels have ordered live-fire training facilities to be retrofitted—or torn down and constructed anew—with filters to keep both the fuels that produce practice fires and the agents that extinguish them from leeching into the ground.

Fire departments have replaced Halon, a favorite firefighting agent but an ozone-eating monster, with a more ecologically friendly foam called Halotron. And cheap, smoky fossil fuels like Jet A, widely burned in live-fire practice pits, are being dumped for less polluting alternatives—one in particular. Liquid propane is frequently substituted for jet fuel because it’s cheap and burns without emitting pollutants. Still, most firefighters don’t care for it.

**Keepin’ it real: Firemen at Seattle-Tacoma International Airport brave smoke in a mockup many mistake for an airplane.**

“It lacks the realism,” says Master Sergeant Kevin Matlock, fire chief at Washington state’s McChord Air Force Base, where he trains enlistees. “We’ve got a lot of young firefighters who don’t know how hydrocarbon fuels react, that don’t know that the fire will burn back on you,” he explains.

Unlike jet fuel, propane smokes only if it is burned too lean (with too little oxygen) or too rich. Because it combusts at a much lower temperature than a complex hydrocarbon fuel, it throws off much less heat. Propane fires also burn less chaotically than jet fuel blazes.

“Jet fuel is really unique because it rolls

and has fireballs—it’s almost got a mind of its own,” says Bill Hutfilz, the training officer for Clark County Fire Department at Las Vegas McCarran International Airport and vice chairman of an airport firefighters’ group devoted to industry education. “Propane doesn’t. Hydrocarbon



FIREFIGHTER JOHN JOHANSEN, PORT OF SEATTLE FIRE DEPARTMENT





**A fire at Boston Logan International was started with Tekflame, but looks like – and acts like – conflagration of Jet A.**

wings folded is a Navy personnel transport. (Because aircraft parking spaces are limited at the airport, the mockup's wings fold to help it fit into tight parking spaces, and to facilitate towing.)

The mockup's story began in the mid-1990s, when construction of a new runway took away the fire department's live-fire training site. For several years, firefighters made do by practicing on traffic cones laid out in the shape of an aircraft. But without an actual object to aim at, nobody could agree on how high, for example, a wing would be and where the hoses and firefighting vehicle turrets should be aimed. In the meantime, the Port of Seattle, which owns the airport, banned live-fire training on airport grounds to prevent environmental damage. Instead, the airport fire department commissioned a \$700,000 smoke-only training mockup. Sea-Tac training chief Rick Kruckenberg led the acquisition project. "It addresses all of the job performance requirements of an airport firefighter," he says, noting that his department runs 18 different drills on the mockup.

Delivered in 2006, the faux airplane is rich in external details: Turbofan engines (they don't work but have inset fan blades), navigation lights, an auxiliary power unit with exhaust. The department trains with the mockup three times a month to keep skills sharp for the annual live-fire exercise at the Washington State Fire Training Academy. Kruckenberg is able to flood the mockup's cabin with opaque gray smoke, a challenge to firefighters as they search for dummies representing trapped passengers.

The interior of the mockup is less realistic than the exterior. It has a single row of overhead lights, and started out with two rows of bench seats. To make the training experience more realistic, Kruckenberg has solicited items to make the interior more like the inside of an airliner. Alaska Airlines has donated several rows of passenger seats, for example, as well as two pilots' seats and evacuation slides.

A final detail signals the direction in which airport firefighting training is headed: The mockup is painted green. ➤

burns a lot blacker and it runs and hides. It's going to get in the cracks in the airplane or cracks in the concrete. Wherever that fuel is, that fire is going to follow."

Despite the trend toward propane, many FAA-approved firefighter training facilities still burn fossil fuels. But a few have managed to strike a balance between environmental stewardship and the realism of jet fuel without turning to propane. The regional facility at Boston Logan International is among them.

In 2005, Paul Callinan, the airport's assistant chief for training, oversaw his department's shift to Tekflame, a hydrocarbon that has been scrubbed of an additive that makes jet fuel burn evenly. The additive, Benzene, also causes much of the smoke that comes from burning fuel.

"I feel that our facility, using Tekflame as the fuel, gives a far more realistic attitude and environment than it would by using propane," says Callinan. But, he adds, "it's very, very expensive—double the cost, if not more, of regular fuel. Eight dollars a gallon, compared to the \$2.90 a gallon we used to pay for jet fuel."

Few airports have live-burn facilities, and sending firefighters off-site for training—either with hydrocarbon or propane—is not cheap. During a training exercise, a larger airport fire department may burn as much as 10,000 gallons of fuel. Tack on the price of water, firefighting foam and chemicals, facility use fees, and transportation, and costs can approach \$100,000.

Because live-fire training is so expensive, and because so few airports have burn pits, some airport firefighting departments have developed other ways to keep skills sharp between mandated live burns.

At Seattle-Tacoma International Airport, firefighters frequently train on what may be the Rolls-Royce of fire props. Unlike the stationary, bare-steel monstrosities set ablaze in pits across the country, Sea-Tac's 85-foot-long, towable mockup with a 67-foot wingspan is so convincing that flight crews often confuse it for a real aircraft.

According to department lore, the airport's air traffic controllers will occasionally tell inquisitive visitors that the strange airplane they see parked with its

FF/EMT LISA BUCHANAN, MASSPORT FIRE-RESCUE DEPARTMENT



# UNMANNED TRAFFIC JAM

*The nation's airspace is crowded enough. Why are entrepreneurs trying to push unpiloted vehicles into it?*

BY DOUGLAS GANTENBEIN





**ABOVE A POTATO PATCH** in the rolling green hills of southwest Virginia, two small airplanes buzz insistently on an August morning, cutting tight spirals through the misty air. Attached to each wing of the small unmanned aerial vehicles (UAVs) are canister-like traps. What they're trapping are tiny sporangia. Potato-blight sporangia.

Elson Shields, a professor of entomology at Cornell University in New York, is an expert in using remote-controlled UAVs as a scientific tool, and the researchers on his team are flying the aircraft. He brought the UAVs to this Virginia potato patch, owned by Virginia Tech University, to help university professor David Schmale. Several weeks earlier, Schmale had deliberately infected a crop of red potatoes with sporangia of *Phytophthora infestans*, the same pest that devastated Ireland's potatoes in the 19th century, sending a million starving immigrants to the United States, Canada, and Australia.

The field is covered with the blackened, curling leaves of dying potato plants. As the sun warms the air, the tiny sporangia take flight on rising air currents, hopping from one pasture to the next. In a matter of days, they may travel hundreds of miles, but little is known about how they travel, how high into the atmosphere they reach, and how long they remain viable once they've taken flight. These are the things Schmale wants to learn. Potato blight is still a threat, with no commercial tuber fully resistant.

Agricultural research is only one of many commercial uses for UAVs. Entrepreneurs across the United States are eyeing them for chores ranging from surveying fields to spotting forest fires to photographing highway accident scenes. But first, UAVs have some hurdles to jump. The idea of the nation's airspace filled with hundreds of pint-size aircraft—some remotely controlled, some operating entirely on their own as autonomous craft—has the Federal Aviation Administration in a cold sweat. While the FAA has been issuing Certificates of Authorization (licenses to fly, referred to as "COAs") for UAVs, the permits are just trickling out, not nearly fast enough to meet the clamor for them. "We're at a standstill because we can't get COAs," says Ross Hoag, co-founder of Cloud Cap Technology, an Oregon company that makes control systems for military UAVs and would like to do the same in the commercial sector.

Above the Blacksburg potato fields, Schmale and Shields conduct two sessions tracking the epidemic's progress. This

morning, persistent fog over the nearby New River grounds Shields' little aircraft fleet. The bright red, yellow, and blue aircraft—built by Shields and his crew—have 10-foot wingspans, weigh 45 pounds, and are powered by 50-cc engines. "It's like flying a semi-truck," says Shields, a tall man with a shock of white hair poking out from under a baseball cap. "They're quite heavy when fully loaded, and they have to be rugged and durable because we often fly from rough airstrips."

By 10:30 the fog lifts, and things happen fast. Shields spins the UAV's propeller and the little engine catches. Grabbing a remote control unit, he toggles the controls to steer the craft down its takeoff path in a roughly mowed field. It bounces a few times, then zooms into the air. A second aircraft soon follows. Shields hands the controls to two support staff ("I take them off and land them," he says), then walks across the field to the planned flight path. In a nearby trailer, a radio downlink feeds computer screens the aircraft's speeds and elevations. The data will be used to ensure the aircraft fly as consistent a path as possible.

Once the craft are airborne, the doors covering the sporangia traps snap open for exactly 30 minutes. By examining the record of each aircraft's speed, the researchers can calculate how many cubic yards of airspace it flew through, determine the number of sporangia in the trap, and compute the density of sporangia in the air.

Flying the mission with piloted aircraft would cost much



**The missions of the Manta UAVs have ranged from monitoring air quality in the Maldives (opposite) to studying glaciers in Greenland (right). But in the United States, they can fly only in military airspace.**





DOUGLAS GANTENBEIN

**While UAVs help scientists conduct research (above, studying potato blight), they require a hefty entourage of operators on the ground. David Schmale of Virginia Tech (right) gathers his crew.**

more, but Shields' fleet of airplanes has its limitations. They require a considerable entourage of operators on the ground: an observer, required by the FAA, to scan the skies for other airplanes, and personnel to change the traps between flights, refuel, and download flight data onto a laptop. And the precision of the UAV's flight paths—critical to accurate measurement of anything from blight spores to insects (which Shields collects by UAV for his own research)—depends upon the skill of the person managing the toggles.

It's easy to see why Schmale and hundreds of scientists, farmers, police, researchers, firefighters, and others believe that capable, easy-to-fly unmanned aerial vehicles can do their bidding. As is the case with dozens of other innovations, these birds were first launched by the military. The skies over Iraq and Afghanistan are fly-specked with UAVs, spotting targets, firing missiles, and scouting for roadside bombs. The key hardware—sensors that give UAVs useful vision and controls that put them where people want them—was developed for military operations. Perhaps as a result, the UAV industry in the United States today is robust, with makers of aircraft, control units, sensors, and more scattered across the country.

Sometimes companies pop up in unlikely places. One nexus of UAV development is Hood River, Oregon. This small town, on the Columbia River, 60 miles east of Portland, is best known for the apples that grow on hillside orchards above it, and for the brisk winds that roar along the Columbia below it, making the sport of windsurfing enormously popular here.

In 1994, the UAV firm InSitu Inc. set up shop across the Columbia in the little town of Bingen, Washington. Several years later, in 1999, InSitu alumni Bill Vaglianti and Ross Hoag decided Hood River looked like a good bet and moved there to launch their own company—Cloud Cap Technology. The firm has emerged as one of the leading suppliers of the brains of today's UAVs—the autopilots and payloads that fly the craft and see what needs to be seen.

Inside the two-story Cloud Cap building, computer geeks mingle with mechanics. Around the building are scattered half-



assembled miniature aircraft and helicopters; workbenches are stacked with electronics gear, computers, and partially constructed control units.

"We make the enabling technology," says Mark Zanmiller, the hardware engineer who leads Cloud Cap's technical sales and marketing group. As sensor technology evolves, inertial and air pressure sensors get both better and smaller; Cloud Cap's designers are now turning out UAV controllers dainty enough to fit in a coat pocket but packed with amazing capabilities.

One of Cloud Cap's competitors is CropCam, a division of a company called MicroPilot, a manufacturer of military UAV control systems. CropCam is essentially a lightweight (six pounds) powered glider, equipped with electronic control systems and a Pentax Optio digital camera. It has a ground-based remote control station, but instead of requiring a pilot-operator, the station is used to input GPS-based waypoints, desired elevation, and other flight parameters. (Manual remote controls can be used as a backup.)

After CropCam takes off, it uses the information sent from the remote control station to fly its route and snap photos. Software stitches the photos together for a seamless look at agri-





COURTESY OF VIRGINIA TECH (2)

the engine and simply tosses the craft into the air. “I have it flying in about 15 minutes,” Blair says.

And the results, he says, are amazing. Using digital photos and a computer program to analyze them, Blair can examine his crops for insect damage, lack of water, and more. “We can verify what’s going on out there in the field,” he says.

Blair was so impressed with CropCam, in fact, that he first became a vendor for the company, then created his own company to market UAVs—still in the prototype stage—of his own design, through PineCreek Precision. Technology such as CropCam or his own PineCreek designs, he says, “is what’s going to save the small farmer in the United States.”

UAVs such as CropCam are light, easy to use, and not very expensive. But bigger, more capable UAVs—also based on military designs—are gaining use, at least where a potential mishap doesn’t put people or property at risk.

Last summer, for instance, researchers from the National Oceanic and Atmospheric Administration (NOAA) flew a pair



**Schmale’s UAVs track the spread of potato blight (right, above) from one field to the next; other craft take photos farmers use to evaluate seed coverage and irrigation (right).**

cultural lands, so farmers can check seed coverage, gauge irrigation effectiveness, and spot early signs of insect infestation. Its high resolution—images taken at 2,100 feet have a resolution of 15 centimeters—“blows satellites away,” says project director Lisa Shaw.

Idaho farmer and UAV convert Robert Blair previously used to monitor his fields with a small, piloted airplane. But getting photographs of his crops that way was expensive—\$6,000 for a survey of 1,500 acres—and the airplane had to be booked weeks in advance. So in 2006 he bought a CropCam for about \$18,000 and began taking his own aerial photos.

Flying the little UAV isn’t hard, Blair says. When needed, he loads the craft into his pickup—its wingspan is only eight feet—and heads to his fields. Using grid coordinates, he programs the flight path and sets the desired altitude (usually 900 feet). After a quick flight check—rudder and aileron function, battery connection, a look around to ensure the airspace is clear—he starts

COURTESY OF CROPCAM





of UAVs over the Greenland ice sheet. Tucson, Arizona-based Advanced Ceramics Research developed the craft, called Manta, for military use. But the pusher-type, propeller-driven craft have a payload capacity (up to 15 pounds) and range (eight to 10 hours of flight time at around 92 mph) attractive to a wide variety of users.

Flying over meltwater-fed lakes atop the ice sheet, the Mantas measured the sunlight penetrating the lakes, allowing researchers to determine their depth and their potential for draining through the ice sheet and out to sea. (Understanding the behavior of the Greenland ice sheet has become critical in recent years, with some scientists predicting that global warming could dump vast amounts of water, now in the form of ice caps, into the oceans.) Because flying over remote areas like the Greenland ice sheet is risky, the task is better suited to unmanned craft.

Perhaps even more ambitious is a NOAA project employing UAVs as hurricane hunters. In 2007, a craft developed by Aerosonde flew into the eye of Hurricane Noel as the fast-growing storm approached the East Coast. The NOAA craft loitered inside the hurricane for nearly eight hours, flying below a height of 325 feet as it measured winds and air temperature. That's far lower than manned hurricane-watching aircraft such as NOAA's four-engine P-3 Orion would dare go.

"It's really useful to take an unmanned aircraft to those lower elevations, as the risk of catastrophe [with a manned aircraft] is just too high," says Marty Ralph, a research scientist with NOAA's Earth System Research Laboratory. Costs also are much lower with UAVs, he says, so more projects can be pursued.

Because of the sheer versatility of UAVs, their missions are for the most part limited only by imagination. A case in point: In April 2008, NOAA experimented with a UAV built by Air-



COURTESY CLOUD CAP TECHNOLOGY

**Swift Engineering built its blended-wing KillerBee for the military, but the UAV could also monitor traffic and storms.**

borne Technologies, based in a town that by November 2008 everybody had heard of: Wasilla, Alaska. The aircraft, called the Resolution, was used in the north Pacific to hunt for ghost nets—drift nets that have escaped from fishing vessels and then float with the current, devastating marine life. (By some estimates, ghost nets in the north Pacific alone cause thousands of birds and marine mammals, such as porpoises and seals, to drown each year.)

The Resolution is equipped with video sensors that can detect anomalies in the water; GPS sensors automatically mark the location of nets it finds, for recovery by boats. While the Resolution takes off and lands with the help of a shipboard pilot, it flies its route autonomously.

Autonomous flight is what really gets UAV supporters enthusiastic. Such aircraft could hunt for forest fires, for instance—or, more usefully (since finding a forest fire is rarely difficult), fly the night missions fire managers rely on to map the size and intensity of a blaze through infrared sensors. For his research on plant pathology, David Schmale could use multiple autonomous UAVs to find and track plumes of airborne pathogens, measuring the plumes' size, direction of drift, speed, and more. In the event of a terrorist attack, such UAVs could track airborne chemicals or biological agents.

And in Utah, where state laws require highway patrol officers to photograph injury accidents, troopers are interested in carrying UAV helicopters in the trunks of their patrol cars. At an accident scene, a trooper could punch in some GPS coordinates and the little helo would take off, buzz over the specified grid, take pictures, and land.

**Aerovironment's Raven flies surveillance missions in Afghanistan and Iraq; it could do the same for homeland security.**



DEPT. OF DEFENSE



For the most part, the machines are here today. The big challenge, says Jonathan How, a professor at the Massachusetts Institute of Technology, is designing an airspace they can fly in. "All GPS tells an aircraft is where it is," says How, who designs autonomy software for UAVs. "Flying safely also requires [knowing] what else is out there." Achieving that will require communication between aircraft, or visual sensors on the aircraft, or data sent from ground stations.

"I understand what they want to do—I heard a DOJ [Department of Justice] guy talking about the Utah proposal," says Kenneth "Doug" Davis, a longtime FAA official who now is running the agency's program on managing UAVs in the national airspace. "But there are 19,000 law enforcement agencies in the United States. Of those, fewer than 300 have aviation units. So less than two percent of these guys have a clue about what constitutes 'airworthiness.'" In terms of teaching potential UAV operators the rules of aviation, he says, "we have a big education gap to fill."

Davis points out that today's UAVs—which can resemble everything from an insect to a small piloted aircraft in size—simply don't fly the way other types of aircraft do. "An airliner operating at 30,000 feet can move 500 knots across the ground," he says. A UAV "might have the thrust to reach 30,000, but then it's moving at only 100 knots. That creates a big challenge for integrating slower aircraft into the airspace."

The FAA issued 165 Certificates of Airworthiness for UAVs in 2008, up from 85 in 2007. The agency, which hopes to pick up the pace, is working on new regulations and plans to start gathering public comment late this year and into 2010.

**Hermes UAVs patrol the Arizona-Mexico border under special rules from the FAA; users hope for standard operating guidelines.**

Still, creating guidelines for operating UAVs is going slowly, and that frustrates plenty of people. "The FAA wants us to show these things are safe, but they make it difficult to fly them to collect the information needed to prove they *are* safe," says Masood Towhidnejad, a professor of computer and software engineering at Florida's Embry-Riddle Aeronautical University who studies potential UAV applications. "Look, I agree with some of the [FAA] restrictions. But I don't agree with others. We all agree with the FAA's position that safety of the public should be the highest priority in any decision they make, and it's unrealistic to assume [the FAA] should allow UAV systems to fly over any area that could result in human loss or injuries, or property damage. However, if the request is for a flight test over an area where there's almost no chance of danger to humans or property—in the middle of the ocean, say, or over a desert—there's still a good chance the FAA won't approve the request. It's obvious that the expected damage generated from the crash of a Predator is much higher than a small six-foot-wingspan UAV. And yet the FAA allows hobbyists to fly remote-controlled model aircraft very close to—or even in—cities, but they don't allow a UAV of the same size to fly the same areas. If we could get more UAVs flying, they could play a major role in society."

Another Embry-Riddle professor, Richard Stansbury, who specializes in robotics, sees fleets of larger UAVs eventually providing delivery services for UPS, FedEx, and other air freight companies. "It just makes sense to have [UAVs] do that," he says.

The day after he and Elson Shields flew their UAVs through a cloud of potato blight, David Schmale returned to the field to test his autonomous UAVs. Three of them took off and began to pirouette through the sky, flying precisely and gracefully, learning to work together to track a pest that could do tremendous damage. It's anyone's guess how much else they could track. ➤







**THAT SPRING**, no true Englishman could enjoy an evening stroll without spotting a zeppelin. “My eye was at once attracted by a powerful light, which I should judge to have been some 1,200 feet above the ground,” said Police Constable Kettle of his March 23, 1909 sighting, reported in London’s *Daily Mail*. “I also saw a dark body, oblong and narrow in shape, outlined against the stars.” His observation was seconded by a Miss Gill, who told the *Evening News* of “a brilliant flashing light in the sky.”

Zeppelins had been flying for nine years, but this was the first time one had been spotted over England. Designed by Count Ferdinand Graf von Zeppelin, the rigid airships were marvels of engineering: 446 feet long, built of 16 linked duralumin rings braced with wire and girders to hold bags of hydrogen in place, the whole structure covered with a cotton skin. But they

had also proven fragile, skittish, and prone to catastrophe: Of the first 10 built, six crashed or burned. By 1909, only two, LZ 3 and LZ 4, had enjoyed some success. LZ 3 made 45 short hops totalling 2,733 miles, while in 1908, LZ 4 made a 12-hour trip of more than 600 miles. But had one really flown from the zeppelin hangar at Friedrichshafen, Germany, to Peterborough, England, and back—a trip of 1,036 miles?

British newspapers continued to report airship sightings: one in Cambridgeshire, another by two constables in Ipswich, an egg-shaped ship over Suffolk. In May, says historian Brett Holman of the University of Melbourne in Australia, who has catalogued the reports, London newspapers carried 49 sightings, including a May 18 account of railroad signalmen seeing “a boat or cigar shape” over Cardiff, in Wales. A zeppelin was even spotted over Ireland, where, according to the

**A zeppelin over the Thames? Dubious sightings plagued London and other parts of the United Kingdom in 1909, in part because newspapers delighted in keeping the rumors alive.**

*Belfast Telegraph*, “the aerial visitant was thousands of feet light [high], and came steadily in the direction of the city.”

The sightings caused the British terrible anxiety. At the time, Germany and the United Kingdom were locked in an arms race. In 1906 the British had commissioned the *Dreadnought*, the fastest battleship in the world, and the most sophisticated in firepower. Germany would launch a fleet of formidable *Kaiser*-class battleships, but it hoped to shore up its naval power with airships. In 1908, German privy councilor Rudolph Martin bragged to *Daily Mail* readers that in the event of a war, a zeppelin fleet would “transport 350,000



# Fear OF Floating

WHAT CAUSED SENSIBLE ENGLAND TO SEE A ZEPPELIN BEHIND EVERY CLOUD? by Dan Vergano

men in half an hour during the night from Calais to Dover.... [W]e would conclude no peace until a German army had occupied London."

Popular culture reflected Germany's threat. The year before the airship reports, the British magazine *Pall Mall* had serialized H.G. Wells' *The War in the Air*, a novel in which a fleet of German dirigibles bombs New York. The following year, Martin elaborated on his boasts, publishing *World War in the Air*, a book that imagines zeppelins bombing block after block of Paris ("Even at high altitudes," says one character, "I heard the sounds of hundreds of people crying for help") and defeating England.

The British "woke up to the idea that the Germans had created this dreadful weapon capable of breaking the [protective] barrier of the British navy," says folklorist David Clarke of the University of Sheffield. "[F]or the first time in its history the island was

vulnerable to invasion from the air."

The sightings went on for four months, with several hundred people throughout the United Kingdom reporting lights and zeppelin-like objects in the sky. Were they on to something?

In truth, the odds of spotting a real zeppelin over the British Isles in 1909 matched the likelihood of seeing Kaiser Wilhelm dancing the can-can at a Paris burlesque house. "No airships could have possibly invaded then," says historian Guillaume de Syon, author of *Zeppelin! Germany and the Airship, 1900-1939*. The engines were reliable only in failing, he adds. Furthermore, zep-

pelin pilots navigated "by observing the roads or looking for landmarks like a church steeple," says de Syon, and those would have been in short supply as a London-bound zeppelin crossed the North Sea. The journey would also carry the ship over Belgium and France in daytime (zeppelins then did not fly at night), creating an international incident at a time when every visit of dirigibles to Europe's skies brought thousands of people streaming into the streets.

Many historians, Clarke says, think the airship scare was worked up by newspapers such as the *Daily Mail*,

## SCARESHIP

"Seen" at Cardiff Early This Morning.

## SIGNALMAN

Tells a Story of Two Headlights and The Dear Old "Whirr."

The searchship, like the young lady in the poem recited to Coster Joe, "DOES 'gn abah!"

After doing a sort of trapeze turn in East Anglia and Belfast, it is giving plucky little Wales a show. The Press Association's Cardiff correspondent telegraphs:—

Early this morning an airship was seen in the neighborhood of Cardiff by a number of persons.

The facts of the occurrence are contained in the following official statement, which has



**SKEPTICAL** *The Star* was amused that a witness claimed to see an airship bearing a pipe-smoking German (left); the *Evening Star* doubted another airship had been "seen" at all (above).



LONDON, SATURDAY, 15 MAY, 1909.

## "INVASION."

Yarn of An Aeroplane in the Night

## ON HAM COMMON.

German Drops from the Sky, Begg Tobacco, and Flies Away!

When the "Star" man upon the case there, were evidence tending to prove it actually been invaded by at were:—

Ham-common (still there) A briar pipe with meers A tobacco-pouch (embroidered)

These pieces of evidence were produced at the "Star" office yesterday by two gentlemen—Mr. C. Verney Grahame and Mr. W. Bond—at least they did not produce Ham-common, but they told our representative where to find it, and so it is included in the "exhibits," as the lawyers say.

### Tales.

For several days the Jingo Press has been publishing stories of a balloon airship, passing over the Eastern counties; to-day an additional thrill it has been located over the King's estate at Sandringham.

But according to the story of Messrs. Grahame and Bond there is an aeroplane here too, evidently of foreign origin, and it descended in the middle of Ham-common at 11.10 p.m., to be exact, on Thursday night.

The story of Messrs. Grahame and Bond is one of the most remarkable our man has heard since he read Jules Verne's "Clipper of the Clouds" (and believed it) at school.

It I said, "Certainly you accept a pipe for it" and I said you would, of course.

"He gave me the pipe—here it is."

### Conclusive.

A briar pipe with an egg-shaped bowl and a meerschaum lining was here produced—third piece of evidence.

The "Star" sleuthhound pounced upon it, to find the words "made in Germany." But the invaders had been too wary—the damning words did not appear.

From subsequent inquiries of Fleet-st. tobaccoists our own sleuthhound finds that such pipes are made in Austria, and that such pipes are forbidden foreigners at about a shilling.

Mr. Bond at this point mentioned that the German gentleman had a cap, and a beard, and a map in front of him. It was fastened on a board, and there were red discs, as though they had been stuck into the map with pins.

### Curtain.

Mr. Grahame told the end of this adventure.



owned by Alfred Charles William Harmsworth, known as Lord Northcliffe. The phantom airship reports spiced up the paper's usual fare and put pressure on the government to increase military spending (one of Lord Northcliffe's preoccupations). And with papers reporting airship spottings day after day, says Clarke, "you get this huge popular delusion."

On the other hand, some papers were openly skeptical about the reports. The *Weekly Dispatch* noted that in one case, an airship was seen at Stamford and 20 minutes later over the coast at Southend; "this would give the airship a speed of 210 miles per hour seeing as the two places are seventy miles apart." For airships of the day, a speed of 40 mph was more like it.

Newspapers also reported cases in which witnesses refuted zeppelin sightings. Daniel Blight told the *South Wales Daily Post*, "The airship was of quarter-circle shape, with two bright lights, one at each end of it.... I drew the attention to it of Constable No. 440C., who was passing at the time, and no doubt he will report it." But the paper also quoted Constable 440C. saying that what he saw that night was "a particularly bright star, and it was there again on Thursday night."

Lord Northcliffe himself eventually called for a halt to the airship craze: In a May 21, 1909 *Daily Mail* column telegraphed from Berlin, he scolded: "Germans who have so long been accustomed to regard Great Britain as a model of deportment, poise and cool-

headedness are beginning to believe that England is becoming the home of mere nervous degenerates." He added that the airship reports distracted from "the real German danger, namely the progress of the accelerated German naval programme."

After Lord Northcliffe's call to sanity, "[t]he airship panic began, by degrees, to subside," writes historian Alfred Gollin in a journal article about the 1909 scare. Newspapers turned from reporting the frenzy to explaining it; the *London Daily Chronicle* quoted an official from a "lunatic asylum" ascribing the panic to "aviation insanity," common among his charges. Another "lunacy expert" told the *Morning Leader*: "In every thousand men there are always two every night who see strange matters, chromatic rats, luminous owls, moving lights and fiery comets, and things like those." And a letter writer in the *Cambridge Chronicle* suggested, perhaps inevitably: "Might not the nocturnal visitor which has so disturbed many of the inhabitants of this peaceful Isle be the invader from a neighbouring planet?"

Some explanations were more mundane. Like the UFO scares later in the century, Clarke says, reports of airships

armed with spotlights often coincided with evenings when Venus shone brightly in the sky. In Wales, pranksters released six-foot-wide fire balloons to spark airship reports. And the *Northampton Mercury* reported a hoax involving an airship model used for advertising motorcars. As for the first sighting, a representative from Constable Kettle's own constabulary told the *Peterborough Express* that "for some days and nights before PC Kettle's vision there was a very fine kite flying over the neighbourhood of Cobden Street.... [T]he kite would have been moored at night, and have a Chinese lantern attached to it...."

"But how do you get over the whirring and beating of engines?" asked the *Express* reporter.

"Oh, that was the motor which goes all night in the Co-operative Bakery in Cobden Street."

At least England's fear of zeppelins was based on real concerns. The same year, other countries that seemed far less vulnerable began getting airship jitters. Says Brett Holman, "People saw [airships] in New Zealand, New England, India, and even parts of Germany." The zeppelin's sheer gigantism—something the size of a battleship hanging in the air—seized the public mind. Milk

## AERIAL BATTLE FLEET.

GERMANY PREPARING FOR WAR FROM THE CLOUDS.  
GREAT PROPAGANDA

By "Express" Private Wire.

BERLIN, Sunday, May 16.  
A new agitation in favour of creating an immense aerial fleet will shortly begin in Germany with the support of many prominent men who have hitherto been ardent advocates of naval expansion. The watchword of this new movement will be: "Let us build Zeppelins instead of Dreadnoughts."

It is pointed out that each of the latest Dreadnoughts costs in round figures two million pounds, and that the latest type of Zeppelin airship can be constructed and of Zeppelins for the cost of one Dreadnought.

There are many expert judges in Germany who are firmly convinced that this country would derive more advantage in practical warfare from forty Zeppelins than from one

There are many expert judges in Germany who are firmly convinced that this country would derive more advantage in practical warfare from forty Zeppelins than from one Dreadnought, and circumstances are all favourable to the new movement.

Its ardent originators and supporters recognise that German naval expansion has temporarily reached its limit owing to the solemn public pledge which Germany has given to Great Britain that her shipbuilding programme as formulated by the Navy Act of 1906, supplemented by the later Navy Acts of 1908 and 1909, shall not be accelerated. This public pledge prevents the German navy from meeting the wishes of the navy enthusiasts, who are therefore turning their energies to another sphere of activity.

LEAGUE OF 3,000,000.

The German Navy League numbers a million members, so that it is expected that the German Aerial Navy League will speedily enroll two or three millions. The extraordinary interest taken in all matters connected with the management of the International Aeronautical Exposition, which will be held this summer at Frankfurt-am-Main, is announced to-day that the international airship races will start from Frankfurt-am-Main on the last two days of August and the first day of September. During August there will also be special days for different foreign nations.

One of the most recent additions to Germany's aerial fleet, the *Parasol*, made

DEEPENING MYSTERY OF NOCTURNAL FLIGHTS.

GERMAN OR ENGLISH?

In reply to inquiries made at the War Office yesterday by an "Express" representative, the belief was expressed that the airship which is flying over the eastern counties is not a foreign one.

The official opinion is that it belongs to an English inventor who is conducting his experiments at night in order to keep his secret. Should the machine prove to be of value the War Office, in accordance with its policy, will be prepared to purchase it.

On the other hand, it is admitted by German experts that the airship may be a German one, and that it may have ascended from some warship in the North Sea.

A close watch is being kept at the coast-guard stations on the east coast.

Another theory is that the airship is a German one, and that it may have ascended from some warship in the North Sea. A close watch is being kept at the coast-guard stations on the east coast.

## WHO OWNS THE AIRSHIP?

BERLIN'S VIEW.

By "Express" Private Wire.

BERLIN, Friday, May 14.  
It is admitted by German experts that the mysterious airship which has been seen hovering over the eastern coast of England may be a German airship. England possesses no such airship, and no French airship has hitherto sailed so far as the distance from Calais to Peterborough.

On the other hand, the performances of several German airships, including the *Gross* airship, which has made one voyage of thirteen hours, would render it possible for them to reach the English coast. At the same time it is improbable that the German airship seen above England ascended from German soil.

An aerial voyage from Wilhelmshaven to the English coast would still be a formidable and dangerous undertaking even for the newest airships, whose performances have been excellent in bad weather. German expert opinion is unanimous in believing that the mysterious airship ascended from some German warship in the North Sea, on which it lands again after each of its flights.

Last December it was announced that the Imperial Ministry of Marine had decided to order four airship cruisers from the Zeppelin Airship Construction Company of Friedrichshafen. Each of the four aerial warships was to be from 12,000 to 14,000 cubic metres in capacity. They were to be built under Count Zeppelin's personal supervision, and all the latest improvements in Zeppelin's system were to be embodied in them. The intention was to station two at Wilhelmshaven and two at Kiel.

FLOATING BALLOON-SHEDS.  
Simultaneously with the construction of the four aerial cruisers the supreme naval authorities proposed to construct a new type of floating docks which, when covered with roofs, were to become floating balloon sheds. Shortly after the original announcement on this subject was made it was supplemented by the news that in view of the fact that the construction of four Zeppelin airships would take some considerable time, the naval authorities would in the meantime purchase smaller airships either of the *Gross* or *Parasol* type.

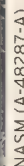
It is quite possible for airships of this type to have been constructed since December, as they can be constructed in twelve weeks.

Another striking point is that *Parasol* and *Gross* airships are portable and could have been conveyed on board warships in separate parts without creating any attention at the time. Owing to the extreme

POLITICAL One theory had England being overflowed by a zeppelin launched from a German warship in the North Sea (above). That paper, the *Daily Express*, also noted Germany's ominous airship buildup (left).



**PRACTICAL** The sightings kept newspapers lively and readers hooked. The *Evening News* (below) noted that “neither party can convince the other,” while the *Evening Star* (right) observed that “the fewer the facts...the more romantic is your story.”



some by explosive bombs which killed four peaceful people, two of whom were women.” By the end of the war, zeppelin-dropped bombs had killed 557 people and injured 1,358. Concludes de Syon: “The airship scares were

just a little neurosis before the actual psychosis of the first World War." —

For no airship is the question  
 dividing all England to-day. As  
 conversation the mysterious fly-  
 ing machine has the great advantage  
 of being inexhaustible; and while all can  
 see and quote their respective  
 views on the side or the other, neither  
 can convince the other.  
 The story from Cardiff is certainly  
 good for the pro-airship party.

---

**DEFINITELY SEEN.**

[illegible]

The airship came from the direction of Newport, took a curve over the docks, and passed over the channel towards Weston, being clearly in view for a minute or two.

If could, it is stated, have been seen larger, but that the lights or lights were suddenly extinguished.

"Had the Dowling Works blast been on," observed one of the eye-witnesses, "we should have had the airship clearly discovered, but we saw enough to put at rest the night about it."

The night was clear, though there was no moon, and the airship could be distinctly seen, and the whizzing of its motor was heard by us all."

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An Aerial Derelict.  
The airship is only two feet long, and there is not a soul on board. Its inventor has merely lost it.  
The individual in question is Mr. Waite, of Upper Bridge-road, Chelmsford.  
He went out upon Galleywood-common near Chelmsford, in the dark hour before the dawn to experiment with his invention. Attaching a rope to the machine, he set the engine going, and grasped the other end of the rope. The airship rose at once, but after it had ascended several hundred feet the rope broke and the ship sailed away.  
The airship measured 18in. across, was 2ft. long, and stood 18in. high when resting on the ground.  
The most distinctive features have been patented, and the War Office authorities had promised to give the inventor a trial.  
"Irish invasion."  
As stated in the Night "Star" yesterday the "Belfast Telegraph" reported that an airship "with brilliant light" disturbed the peace of the good folk of Belfast. The police are to travel as fast as they can, and aeroplanes are reported to have been ordered.  
According to the "Star," which reports the apparition, "about ten o'clock a night" a brilliant light was observed in the sky in the direction of Colin McGinnis's farm. When it was seen that it was in motion aeroplanes were turned to it, and its course was followed with interest was thousands of feet high, and came steadily on in the direction of the city, occasionally dipping under

In spite of the efforts of certain of the appointed newspapers to discredit the reports concerning the mysterious airplane which have been furnished by "Express" correspondents, the fact of its existence becomes more firmly established and the mystery increases as efforts are made to discover its home fall to meet with its cost.

That is the beauty of a mystery; the fact that you are able to get the more romantic story.

—XNYT story.

JUNE/JULY 2009 AIR &amp; SPACE | 61



# *The Dawn of* **DISCIPLINE**

**A B-47 PILOT REMEMBERS WHEN AN AIRPLANE – AND CURTIS LEMAY –  
STIFFENED THE SPINE OF THE STRATEGIC AIR COMMAND.**

**BY WALTER J. BOYNE**





**I GOT MY FIRST GLIMPSE** of a Boeing B-47 on an April morning in 1954, when I was a U.S. Air Force first lieutenant with about 450 hours in bombers. I was walking out to fly a rather staid base aircraft, a Beech C-45, and saw the B-47—glistening in the California sun and trailing long plumes of exhaust—land at my home station, Castle Air Force Base, the first of the 45 to be assigned there.

I'd seen photographs of the bomber and read about its potential. The first time I saw the real thing, though, I was racked with envy, for at that moment, there was little prospect of my flying the B-47. (No one but Boeing publicists ever called it the Stratojet.) I was in the process of becoming an aircraft commander in the Boeing B-50, an upgraded version of the B-29, and the new, super-hot, Jet Age B-47 required even its copilots to have far more flying time than I had.

But being young and foolish had some virtues. Only weeks later, after seeing the majority of my pi-

lot friends in the 330th Bomb Squadron sent off to McConnell Air Force Base in Wichita, Kansas, for B-47 training, I stormed into the ancient Quonset hut that served as the squadron commander's office to demand that I too be sent.

Fortunately, the commanding officer wasn't in (he would have thrown me out on my ear). After I pounded on the adjutant's desk, the good-natured officer immediately had orders cut to send me on my way to meet an aircraft that I would come to love. In the intervening decades, the B-47's airliner offspring have turned us into a nation of jetsetters, making it difficult to convey just how thrilling the prospect of flying the jet was to a young bomber pilot. (Perhaps more remarkable, today's commercial transports exceed the subsonic performance envelope of the B-47 by only a small margin.)

In the early years of the cold war, B-47s served as the spearhead of the Strategic Air Command, with the bomber fleet varying in size from 1,000 to more than 1,500 B-47s. We felt that we were the premier force, an unsolvable problem for the Soviet Union. Each B-47 carried as much firepower as a thousand World War II-era B-17s and B-24s, and each was capable of penetrating to the heart of enemy territory. The pleasure we found in flying the airplane, however, was not in its capacity for lethal warfare but rather its sparkling performance. In the early 1950s, freed from banging piston engines and whirling pro-

**As a young pilot, Walter J. Boyne couldn't wait to fly the U.S. Air Force's hot new bomber: the swept-wing, jet-powered Boeing B-47 Stratojet.**



NASM-7A05609-P

USAF



pellers, you sat under a beautifully streamlined canopy, peering out at thousands of square miles of territory, cruising along at seven miles a minute in a jet bomber. It was intoxicating.

My wife Jeanne was not happy with my volunteering to fly the airplane. By 1954, everyone, including pilots' families, knew that this aircraft, while magnificent, was also very unforgiving. The B-47's cutting-edge design pushed the boundaries of both aerodynamics and pilot experience. Yet for young pilots eager to enter the Jet Age, knowing that the aircraft could be difficult heightened the pleasure of flying it.

When the B-47 was introduced, it was simply too radical in its aerodynamics and in its demands for unrelentingly professional airmanship. The new United States Air Force was still operating under World War II attitudes. New swept-wing jets demanded much higher standards, yet far too little emphasis was placed on safety and rigorous training. Accident rates and fatalities skyrocketed. The B-47 was unusual in that through 1955, the accident rate rose with the number of flying hours, then stabilized for four years (see "A Dangerous Ride," p. 67). From 1959 through 1962, the rate shot up again when structural fatigue and revised tactics imposed new stresses.

In 1957, there were 28 fatal accidents and 63 deaths. The common denominator of the accidents was that the circumstances were routine, familiar. In case after case, there was some minor but fatal human error. In a fast instrument let-down, the pilot might turn the wrong way and run into a mountain. Misreading an altimeter led to a smoking hole in the ground. A 15-second lapse of attention in a descending turn could let airspeed build so fast that a safe recovery was impossible. In earlier, more forgiving air-

craft, these mistakes might have been survivable, but in the B-47, they were disastrous. Some accidents were caused by maintenance errors, but these were less common. All too often the accident investigation ended with the heartless but accurate phrase "pilot error."

In today's Air Force, where bombers are few and terribly expensive, an accident rate approaching that of the B-47 would be unacceptable, and Congress and the public would be justifiably up in arms. In the early days of the cold war, however, it was just business as usual.

To the bomber pilots who flew the aircraft, the B-47 offered fighter-like performance, a vast improvement over the B-29s and B-50s we had been flying. Besides its swept wings and six jet engines slung in pods beneath the wings, the B-47 was unusual in

**Right: The author flew this B-47 to Edwards Air Force Base in California at the end of its long flying career; there, to his heartbreak, it was hung like laundry between two towers to serve as a radar target.**



**Boyne (back row, fourth from left) was a member of the 4925th Test Group (Nuclear) at Kirtland Air Force Base in New Mexico. In addition to two B-47s (not pictured), the group's fleet included two Boeing B-52s (one is pictured in the rear) and three fighters – from left, a Lockheed F-104, a Fiat G-91, and a North American F-100.**







other ways. Its bicycle-style landing gear had it rest on the ground in takeoff attitude, stabilized by two outrigger gear. The high-aspect-ratio wings, spanning 116 feet, were very thin and flexible, so much so that in turbulence it sometimes seemed as if a vibrating outboard engine might simply rumba off the wing. The wings were too thin to serve as tanks, so fuel had to be stored in the fuselage (and in wing drop tanks), and fuel management, particularly during aerial refueling, was critical to maintain the proper center of gravity.

Because of the B-47's weight (sometimes exceeding 200,000 pounds), the takeoff roll had to be augmented by water-alcohol injection and even, sometimes, by rocket-assisted takeoff. The XB-47 was so advanced that even its designers didn't know what to expect; one of them told me that when he watched it taxi on its first takeoff, he was not absolutely sure it would fly.

But fly it did, on December 17, 1947, with Bob Rob-

bins and Scott Osler at the controls. The first flight, a 52-minute cruise from Seattle's Boeing Field to Moses Lake, Washington, was uneventful, and the aircraft embarked on a promising but troubled development period before it entered service. (Sadly, Osler later died in a B-47 canopy malfunction.)

The introduction of the B-47 coincided with the massive makeover of the Strategic Air Command by General Curtis E. LeMay. He assumed command of SAC in 1948, and found that the pell-mell of post-World War II demobilization had left it in shambles. SAC had become a comfortable Air Force-subsidized flying club, where discipline was slack, standards low, and procedures wildly variant. LeMay began an intensive effort to acquire modern aircraft, standardize procedures, improve training, and impose an iron discipline. Although he was successful, the transformation took time.

Joining the 93rd, I entered SAC at the very end of the command's flying club heyday. While the B-50

**A Boeing KC-97 gasses up a B-47 below it. Refuelings between the two aircraft started off in level flight, but as the B-47 took on fuel and became heavier, it had to increase its speed to avoid stalling. To keep up with the faster B-47, the KC-97 had to descend.**





USAF (2)

**Fully fueled and loaded B-47s sometimes needed a rocket boost to get airborne (above). Early B-47s had 18 rocket units built in, while later models had 33 fitted to a horseshoe collar that was jettisoned after takeoff.**

**Boeing engineers discovered that suspending the engines in pods reduced the hazard of an engine fire.**

was a good aircraft, many of the crew members were World War II veterans who were not yet impressed by the stern demands of a non-shooting cold war. As an example, my first flight as a B-50 copilot included a gunnery mission. During the preflight, I observed boxes of ammunition being loaded into the cavernous bomb bay. With the ignorance of youth, I approached the senior gunner and deferentially asked, "Sarge, wouldn't it be better to load the ammunition in the fuselage, so we won't have to depressurize to get it?" He smiled and said, "Don't you worry about it Loooooooootenant." (Veteran non-commissioned officers could put an inflection on the word that revealed your insignificance.)

Midway through the mission, we flew out to the bombing range off Point Mugu, opened the bomb bay doors, and jettisoned the ammunition boxes. The gunners marked their firing score as 100 percent (and they didn't even have to clean the guns). Similar light-hearted chicanery went on with the radar bomb scoring, the navigation legs, and so on, until one Monday morning we went to work and found the old leaders had been fired and a whole new management

team put in charge. As had happened elsewhere in SAC, base by base, flying went from sometimes frivolous fun to the serious pursuit of the mission.

As he molded SAC to his standards, LeMay was largely responsible for converting the B-47s from maintenance-plagued, accident-prone nightmares into a fleet of the most powerful bombers the world had yet seen. At its peak, SAC employed 1,560 B-47s, primarily as nuclear bombers but also for reconnaissance and electronic warfare. Their projection of power deterred the Soviet Union's huge army from overrunning Western Europe. Although none of us was privy to the entire war plan, we believed that in less than a week our B-47s could roll up the Soviet Union from the outside in, cutting off its invading armies and ending the war.



**IN MAY 1954**, I arrived at McConnell Air Force Base and was crewed up with two fine officers, Major Harold McCarty, the aircraft commander, and Captain John Rosene, the radar observer. They were probably not too thrilled to have a low-time copilot on board, but they were polite.

The instructors were very experienced, and during training, they pointed out what made the B-47 capable and what made it dangerous. One of the most talked-about of the latter qualities was the fabled "coffin corner," a point in the flight when the aircraft's weight and altitude rendered the difference between a high-speed stall and a low-speed stall negligible. Recovering from a high-speed stall required a swift reduction in power to allow the speed to bleed down to a point where you re-established control. Recovering from a low-speed stall was more conventional. You lowered the nose and applied power, if necessary. The trick was to recover from one without transitioning into the other. In my view, the danger of the coffin corner was overblown, for if you executed correctly a well-planned mission, you would not find yourself in a situation where it might occur.



Flight control issues were far more important, especially the need to react with the correct control inputs if you lost an outboard engine as you neared the takeoff point. The loss of power on the far right (number six) engine, for example, would cause a loss of lift on the right wing, initiating a roll to the right. In a piston-powered aircraft, the traditional reaction was to turn the control wheel to the left, which raises the left aileron and lowers the right one, thus raising the right wing. In the B-47, however, the correct procedure was to boot in rudder pressure to lift the right wing, and you had to do it within 1.7 seconds of the loss to be effective.

Many a squadron briefing was spoiled by film clips of heavily laden B-47s caught at the wrong moment: as an engine failed on takeoff. The films would show

the wing going down, the wrong control inputs applied, and then a veering, bounding cartwheel ending in a huge explosion, a sea of flames, and deaths.

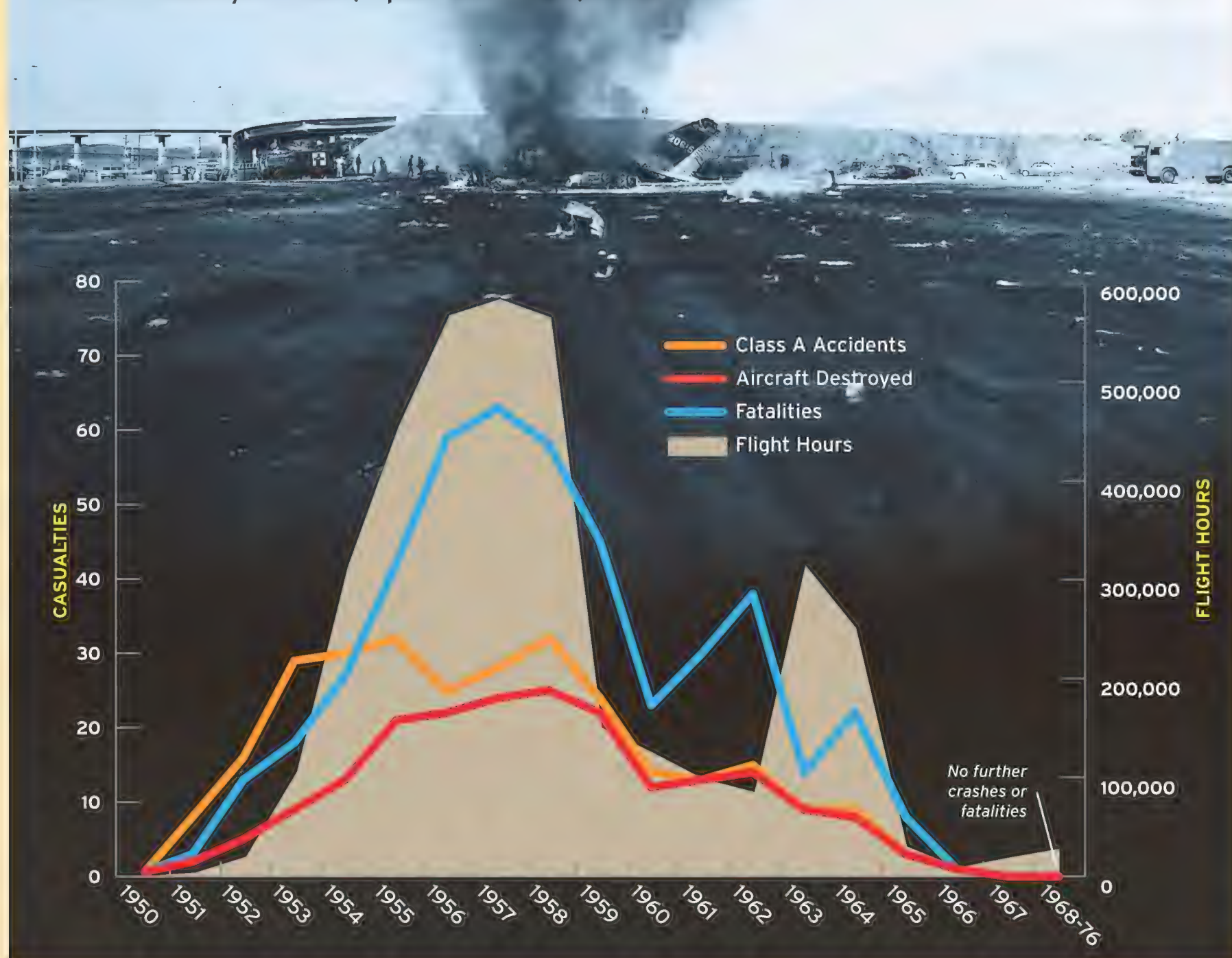
But despite the dangers and the new techniques required, flying the B-47 was a joy. Far more maneuverable than the bombers it replaced, it had superb visibility. In the B-50, you labored through a takeoff and wheezed to altitude, the piston engines gasping for air. In the B-47, you blazed down the runway and climbed out at an exhilarating 310 knots (355 mph)—faster than the B-50 cruised. You slowed gradually until you leveled off minutes later at the optimum altitude, perhaps 30,000 feet, well above most of the traffic of the time. The cruise speed was typically Mach .74, about 420 knots true airspeed.

While takeoffs required good technique, they were

**Scenes like this (below) were all too common at B-47 bases until General Curtis LeMay instituted a strict flying safety campaign that eventually lowered accident rates.**

## A Dangerous Ride

**THE AIR FORCE DEFINES CLASS A ACCIDENTS** as those that result in death or total and permanent disability, loss of an aircraft, or property damage of \$1 million or more. In its lifetime, the B-47 had 288 Class A accidents, with 203 destroyed aircraft (10 percent of the fleet) and 464 deaths.



SOURCE: US AIR FORCE



**As the Soviet threat grew, the Strategic Air Command sought to reduce its response time by stationing B-47s at overseas air bases (below).**

**While two 1,780-gallon drop tanks increased range, they also marred the bomber's clean lines and produced drag (bottom).**

not (unless you lost an engine) as demanding as landing. Setting the B-47 down safely required careful attention to weight, balance, and airspeed. The bicycle gear required that you touch down on the aft gear first. Touching down hard on the nose gear sometimes resulted in a series of porpoising bounces that could grow in size and end in disaster.

The landing problems stemmed primarily from the very clean design of the aircraft, which made deceleration difficult, and the still-primitive nature of the early jet engines, which accelerated slowly. These two factors made it necessary for the pilot to employ a long, low final approach.

The General Electric J47 engine was a workhorse, the later models generating 7,200 pounds of static thrust with water-alcohol injection, but accelerating from the low rpm of the engines at idle to full power still took up to 20 seconds. In the event a B-47

pilot decided to abort a landing and go around, his application of the throttle did not get an immediate response. Boeing overcame the problem by installing an approach chute: Derived from German practice, the 16-foot-diameter ribbon parachute was deployed to increase the drag of the aircraft, allowing engine power to be increased to maintain the desired airspeeds. If a go-around was necessary, thrusting the throttles forward would provide almost instant power because the engines were being made to work at the higher rpm necessary to overcome the drag of the parachute.

Life as a Strategic Air Command B-47 pilot was fascinating. We logged as many as 60 to 80 hours per month, and the experience facilitated proficiency. Mission lengths varied from six hours to 24. On the latter missions, pills that worked like Dexedrine were supplied to ward off fatigue. My aircraft commander, Major McCarty (I never called him Hal or Harold, believe me), was a good guy who drove a Muntz Jet convertible and, even better, gave me a good share of the landings and inflight refuelings.

Initially, we refueled the B-47 from the Boeing KC-97. Despite its four big Pratt & Whitney 4360 radial engines and two J47 jet engines, the KC-97 had trouble refueling the B-47 because it was so much slower. Refueling often began in level flight at some middling altitude, but as fuel was transferred, the B-47 became heavier, so we had to go faster to avoid stalling. The KC-97 could keep up only by entering a descent. I recall one refueling when the KC-97's number-one engine failed, emitting a huge black cloud of oil. The big tanker decelerated like a rocket



USAF (3)



in reverse, disappearing behind us. Fortunately, the KC-97 passed back over, rather than into, us, for we would have had no time to react. (Later, we benefited from the introduction of the swept-wing Boeing KC-135, which flew at higher altitudes and airspeeds than the KC-97.)

The continuous training in the B-47 was intense, and we were always aware that the reason for our existence was a nuclear strike mission. SAC crews were also burdened by a stark fact that other U.S. flight crews had never faced: If the worst happened and we were launched on a nuclear strike against the Soviet Union, we would fly with the knowledge that our families were at risk from a Soviet counter-strike. The supreme tragedy would have been our returning from a combat mission to find our families gone.

**THE 93RD BOMB WING** was selected to be the first in SAC to convert to the Boeing B-52, and there was no way that I could wangle my way into a crew, for the minimum flying time required for a copilot was then 1,000 hours. By a stroke of good fortune, I was given orders to go to the University of California at Berkeley to finish my degree. Next, by an even luckier stroke, I was assigned to the 4925th Test Group (Nuclear) at Kirtland Air Force Base in New Mexico.

The 4925th was an elite outfit dedicated to developing and testing nuclear weapons for the Air Force. It was small: two B-47s, two B-52s, and a handful of century-series fighters. The pilots were very experienced, many of them veteran B-47 instructors from McConnell. The radar observers were equally good. Unlike SAC crews, we did not fly as designated crews, and could be current in more than one type of aircraft. I quickly checked out as a B-47 aircraft commander and began my most fascinating period of flying. Missions were shorter than in SAC, and there was no alert duty, but the test requirements were extremely stringent and called for pushing the aircraft to its limits.

Almost every day we had a different mission. They ranged from high-altitude drops of nuclear “shapes”—dummy bombs with the shape and weight of a nuclear weapon—to very-low-level bomb runs.

Getting comfortable in any aircraft takes time. I realized I was finally comfortable in the B-47 when, on a newly qualified pilot’s first night mission, I sat in the back seat. After a short flight we came back to land, and the pilot made the classic mistake of touching down front gear first. The aircraft immediately bounded upward, the first step in the familiar “bounce to a crash” sequence. But because I was familiar with the aircraft, I popped the brake parachute at the top of the bounce. The aircraft immediately lowered onto the aft landing gear, making the pilot feel pretty good—and me really smug.

The hybrid ancestry of the B-47 posed challenges



for its crews. When the bomber was designed, engineers did not understand the stresses imposed by high speeds, prolonged exposure to sub-zero temperatures, and repeated cycles of takeoffs and landings. As Soviet defenses grew more sophisticated, the Air Force developed new low-level tactics for the B-47, which imposed even greater stress on its structure. As a result, metal fatigue and corrosion took a greater toll.

Ultimately, Secretary of Defense Robert S. McNamara called for the removal of the B-47 from service; he believed the B-52 and the new family of intercontinental ballistic missiles provided sufficient deterrence. The B-47s were flown to the boneyard at Arizona’s Davis-Monthan Air Force Base, with only a few retained for special duties. The Air Force’s last B-47 ended service in 1969, and a single Navy aircraft was used to test electronic systems through 1976. The final flight of a B-47 was made in 1986, when a sketchily refurbished example was flown from the Naval Air Weapons Station at China Lake to Castle Air Force Base to become a museum piece.

Boeing’s initial \$14 million investment in the project paid off handsomely, leading to the production of 2,042 B-47s, including those that Douglas and Lockheed produced under license. The program provided the engineering and financial prowess necessary to create the successful military aircraft that followed it. All succeeding Boeing airliners, and indeed, most commercial jet airliners of all countries, followed the B-47’s configuration. The latest Boeing airliner, the 787, and even its arch rival, the Airbus A380, feature swept wings, tail surfaces, and nacelle-suspended engines—all derived from the B-47. —

**Early in the cold war, B-47s sported white undersides, intended to reflect away the heat from the explosions of the nuclear weapons they were to deliver. Thankfully, such protection was never needed.**



# Sightings

PICTURES WORTH A SECOND LOOK



**WE'VE BEEN CAPTIVATED** for years by the work of Max Haynes, who sees photography as a narrative art. His Web site, [www.maxair2air.com](http://www.maxair2air.com), is a collection of stories he tells through photographs. Here is Haynes describing the process in his own words:

"I examine the graphic elements at play that create a story. I look for juxtapositions of light and dark, or, as we photographers call it, positive and negative space. Silhouettes provide the most dramatic examples of this contrast.

"In the case of a crewman polishing a Grumman F7F Tigercat known as *Big Bossman* [above], I kept snapping the shutter on a mid-September day in 2008, waiting for the man's arms and face to present the best outline against the Nevada sky. During the Reno National Championship Air Races that month, from sunrise to sundown, the crews were always busy bringing the airplanes up to maximum efficiency.

"At the Wing Nuts Flying Circus airshow in Tarkio, Missouri, in July 2008, the black surfaces of a Cessna Bobcat [right] showed every drop of rain beading on its wings and engine cowling, telling the story of a rain delay.

"Kenny Bryenton [below right] stepped off the cliffs of the Torrey Pines Gliderport near San Diego and into the great beyond. An overcast sky in February 2007 rendered this intrepid flier an icon of the simple angles of hang glider flight.

"And five hoppers [opposite] were part of a group of kids who got to meet the U.S. Navy's Blue Angels after hours at Thunder Over Michigan, an airshow at Willow Run Airport near Detroit, in July 2007. They were kind enough to jump for joy again and again so that I could capture them in the air all at once. I got lucky when their timing conveyed a sense of liftoff in sequence. Now, if only I had gotten them to do it left to right."









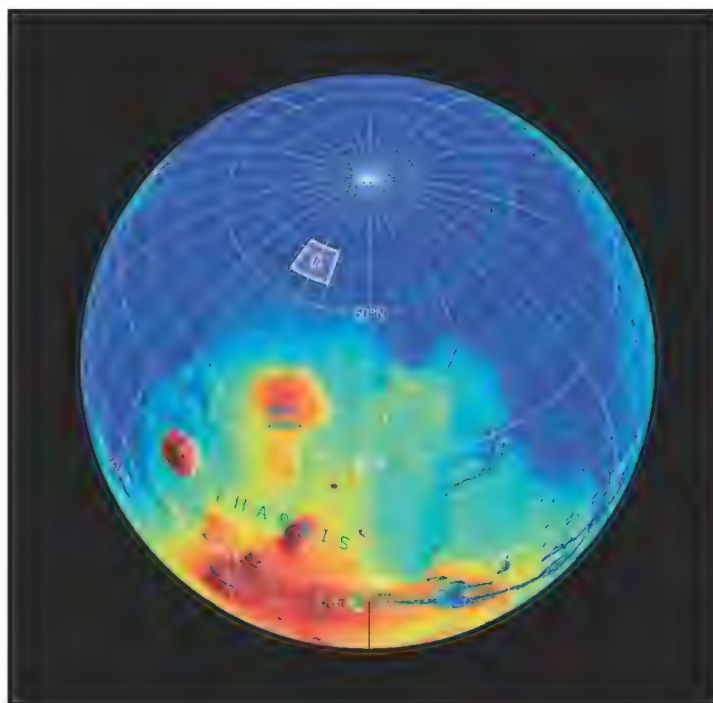
## Mars Travel Guide

**PEERING THROUGH** a telescope on the roof of Milan's Brera palace in 1877, Italian astronomer Giovanni Schiaparelli sketched the first detailed map of Mars. He dutifully named its "seas" and "canals" but then insisted that what looked to him like lines on the surface must be artificial *canali* or "channels" (translated into English as "canals"). It was a mistake that astronomers would try for decades to validate in hopes of finding intelligent life on Mars.

It didn't help that Schiaparelli was nearsighted and colorblind, or that he couldn't make out much due to the limitations of his 8.6-inch-diameter telescope and the blurring effects of Mars' wispy atmosphere (scientists now believe what he saw were probably dust streaks or sand dunes). All telescopes present an inverted image; Schiaparelli, following the conventions of his time, mapped the southern hemisphere where the northern is.

Astronomers today have the advantage of sophisticated spacecraft with near-perfect eyesight and instruments to map the planet in fine detail. Starting with Mariner 9 in 1971, a succession of orbiters, landers, and rovers have taken readings of Mars in a variety of ways and wavelengths. The planet has been mapped for elevation, daytime and nighttime temperatures, surface minerals and elements, magnetic fields, and gravity. Cameras from orbit have been able to discern features as small as seven inches (compared to 20 inches for the best commercial satellite images of Earth).

All the Mars images—along with historic maps—can be seen in a new mapping tool on Google (<http://earth.google.com/mars>). Released



**With data from NASA's Mars Global Surveyor, scientists mapped Martian topography (top), with "D" the planned destination for the Phoenix lander. The map is a vast improvement over Giovanni Schiaparelli's 1890 sketch.**

in mid-March, the tool allows users to "fly" over a 3D view of Mars, and explore its imagery and terrain. "All the data is public domain; we cooked it and stuck it in there," says Noel

Gorelick, a former Arizona State University Mars researcher who now runs the Google feature.

A history buff, Gorelick has mixed feelings about Schiaparelli's map. "It got lots of people interested in Mars, which is a good thing, but he set Mars cartography back 50 years because people were trying to verify these canals. He drew them in a way that could only be interpreted as artificial."

Scientists at NASA's Ames Research Center and at ASU, which has built several Mars cameras, helped Gorelick compile images of the planet from past and present spacecraft, including Global Surveyor, Express, Observer, Odyssey, Pathfinder, Phoenix, Reconnaissance, and Viking.

"We're almost done with the global map," says ASU's Phil Christensen, project manager for a thermal emissions camera aboard the Odyssey orbiter. "We've taken just about all the wavelengths and sensors and flown them to Mars."

What's left, he says, might be a mission with a synthetic radar imager to map the roughness of the terrain. Such a radar, which can penetrate a few feet beneath the surface, has been used on the space shuttle to map Earth's terrain. Turning the tool on Mars would perhaps fill in the missing pieces of a puzzle Schiaparelli left the world more than a century ago.

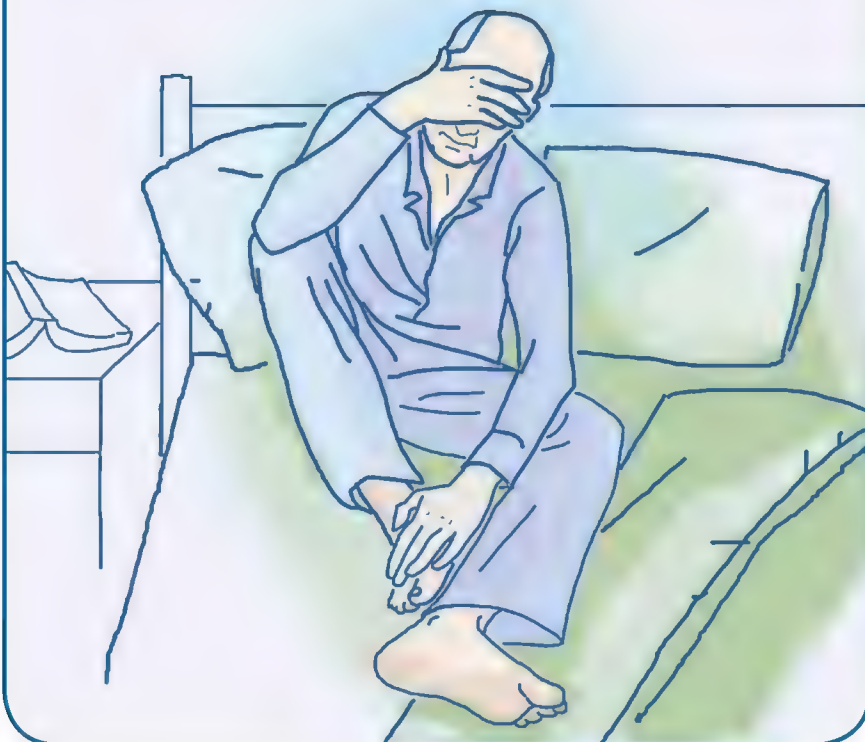
PAUL HOVERSTEN



# Diabetic Nerve Pain?

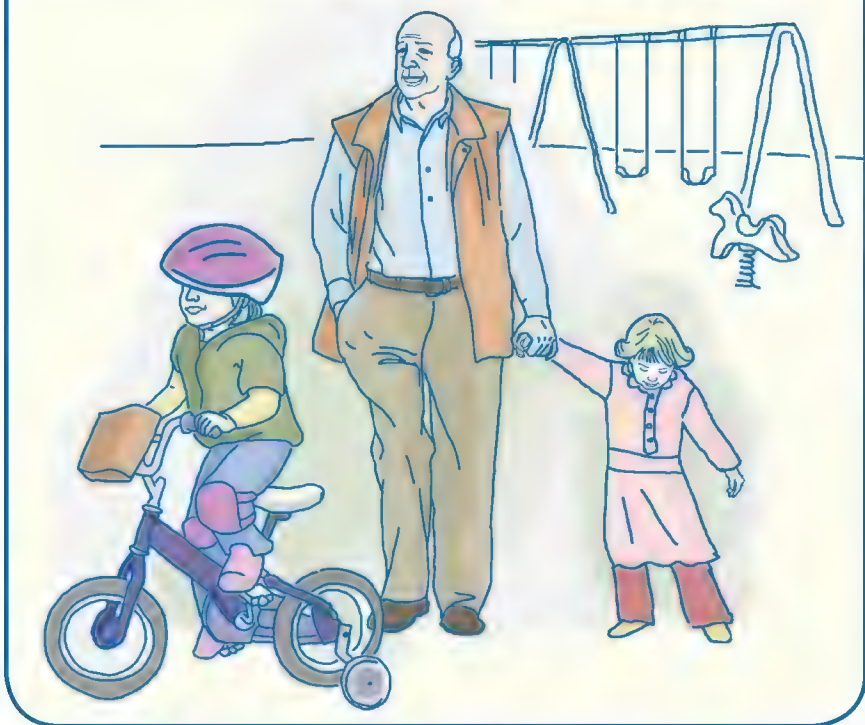
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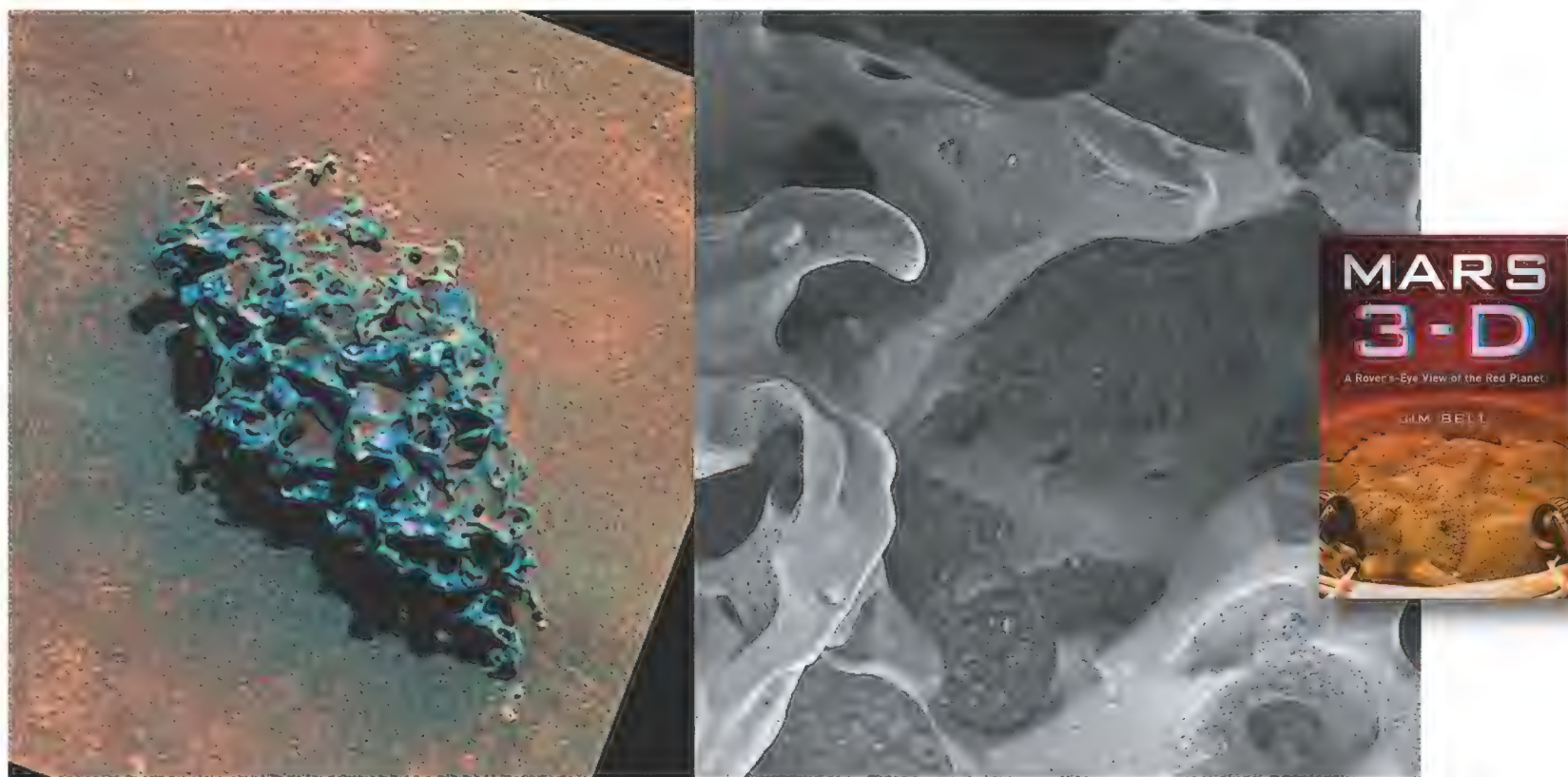


# Reviews & Previews

BOOKS, MOVIES, CDS, STUFF TO BUY

## Here's Looking at You, Mars

Images taken by the *Spirit* and *Opportunity* rovers show off the rugged beauty of the Red Planet – in 3-D.



### ***Mars 3-D: A Rover's-Eye View of the Red Planet***

by Jim Bell. Sterling Press, 2008. 160 pp., \$19.95.

**EVEN BEFORE PAGE 1**, *Mars 3-D* has an irresistible teaser. The front cover dangles open like a centerfold to reveal a built-in pair of 3-D glasses—one candy-blue lens, one strawberry, plus an oval hole to insert your nose. It's nerdy—and inspired.

Like the best picture books, this one chronicles a fantastic journey through a faraway land: the adventures of the *Spirit* and *Opportunity* rovers in 2004. The golf-cart-size heroes use robotic drilling arms to uncover buried scientific treasures, and they overcome dangers like getting stuck in the Red




Planet's purgatorial sand dunes.

And like picture-book heroes, the rovers made the best of their trials: While immobilized, they took hundreds of 3-D pictures. Some, frankly, aren't that interesting. Fields of rocks look better in the conventional photographs the rovers also snapped. But scenes with cliffs or sinuous dunes surfing off into the horizon pop and buckle on the glossy pages. The best stereoscopic pictures are of objects with sharp edges and protrusions, and barren Mars has plenty. You'll swear some pages have false bottoms.

Far from being a gimmick, author Jim Bell explains, 3-D photographs helped NASA scientists on Earth form

**A heavily eroded surface on Mars reveals a piece of basalt, a type of volcanic rock (left). A microscopic image shows that dust has lodged in the basalt's pitted structures.**

computer models of the Martian landscape so they could maneuver *Spirit* and *Opportunity* around traps. That's undoubtedly true. But you can't help hoping that every so often NASA scientists donned a pair of blue-and-red geekers and killed a couple hours reaching their hands out to touch and going "Oooh!"

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## Reviews & Previews

### *MiGs Over North Vietnam: The Vietnamese People's Air Force in Combat, 1965-1975*

by Roger Boniface. Hikoki Publications, 2008. 176 pp., \$54.95.

#### CONTRARY HISTORIANS

have made it a practice to go back after some years have passed to count combat claims of both sides in a conflict, whether it be bombs on target or aircraft destroyed in aerial combat. The reward for the effort is proof that claims were inflated, which, to some, is as satisfying as the discovery of buried treasure. The author of this account, acknowledging help from the Ministry of Foreign Affairs of Vietnam as well as the Air University Library at Maxwell Air Force Base in Alabama, sets the record



straight about the air war in Vietnam.

There's a brief history of how the North organized an air force, then a chronological telling, from the North Vietnamese perspective, of all phases of the air war, including the Gulf of Tonkin

Incident and the raids that followed to the final B-52 surges that were linked to the Paris peace talks and the U.S. withdrawal from the war.

Military historians will welcome the depth of detail in the narratives of key engagements, as well as glimpses of the North's state of

mind at various intervals. The intervening years have mellowed most of the U.S. combatants to a point where they probably will not mind the passages in which the author can barely conceal his affinity for the North Vietnamese cause.

## >>> Pieces of Apollo <<<

**MARK THE 40TH ANNIVERSARY** of the first manned moon landing by wearing this cotton T-shirt (1). The front features a navy blue background with "Smithsonian National Air and Space Museum" in white letters. The back of the shirt has an image of an astronaut standing on the moon. Adult sizes S, M, L, and XL for \$18. XXL for \$20.

Inspired by the Apollo 11 mission patch, this four-inch-diameter iron-on (2) symbolizes the call sign of the mission's lunar lander: "Eagle." \$8.

Relive Apollo 11 in three dimensions via *Moon Landing*, a pop-up book (3) by R. Platt and D. Hawcock (Candlewick, 2009). The book also includes a reenactment of Alan Shepard riding his Mercury capsule into space aboard a Redstone rocket on May 5, 1961 (below). \$29.99.

All items can be purchased from the National Air and Space Museum by calling (202) 357-1387 or -1388. For additional gift ideas, visit [www.smithsonianstore.com](http://www.smithsonianstore.com).





## >>> At a Glance: Apollo 11's 40th Anniversary <<<



### *Spacesuits: Within the Collections of the Smithsonian National Air and Space Museum*

by Amanda Young and Mark Avino. powerHouse, 2009. 128 pp., \$29.95.

Young, the caretaker of the Museum's spacesuit collection, writes about preserving such treasures as the suit worn by Apollo 11 astronaut Michael Collins.

### *Voices From the Moon: Apollo Astronauts Describe Their Lunar Experiences*

by Andrew Chaikin. Studio, 2009. 224 pp., \$29.95.

The author recounts the lunar missions with never-before-published quotes from his extensive interviews with the Apollo astronauts.



### *Apollo: Through the Eyes of the Astronauts*

by Robert Jacobs. Abrams, 2009. 132 pp., \$24.95.

Apollo astronauts talk about their favorite mission photographs.

### *Paper Astronaut: The Paper Spacecraft Mission Manual*

by Juliette Cezzar. Universe, 2009. 208 pp., \$27.50.

Sixty-four pages of cutouts enable you to assemble paper models of the world's spacecraft.



### *One Giant Leap: Apollo 11 Remembered*

by Piers Bizony. Zenith Press, 2009. 160 pp., \$35.

With color photographs, the book presents a complete picture of Apollo 11, from launch to moonwalk.

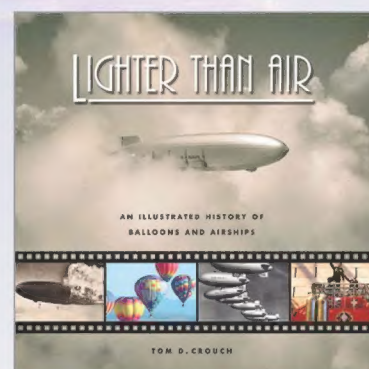
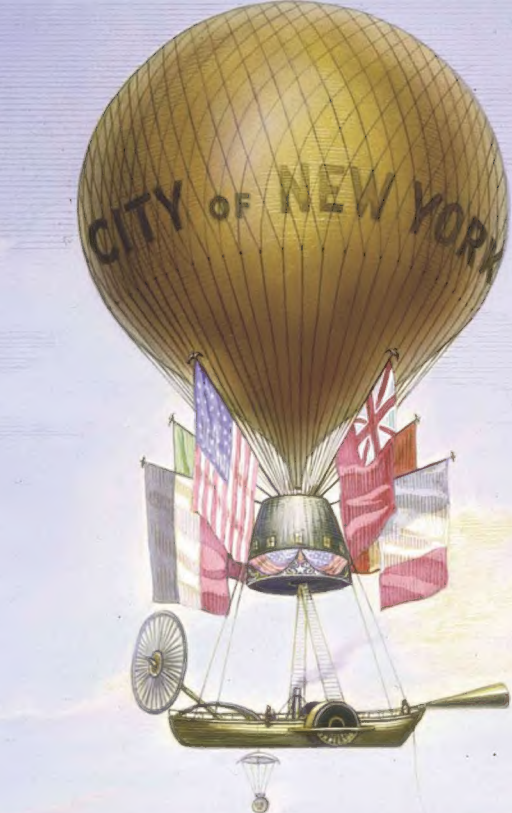
It's of little matter, and after all, the book probably couldn't have been written without pleasing those who hold most of the content.

American readers will probably accept some axe-grinding in exchange for the opportunity to read in depth about an opponent that has been utterly obscure until now. Losses created suffering and sorrow on both sides, though only one ran a Hanoi Hilton. But if Senator John McCain says he can set all that aside, then readers who were at a greater distance from it can surely do the same.

Frontline combatants are almost always members of a nation's younger

generation, and photographs of such North Vietnamese pilots as aces Nguyen Van Coc and Mai Van Cuong remind the reader of the similar faces of U.S. Navy and Air Force hotshot pilots. Aircraft buffs will be mildly disappointed that the book contains scant in-depth comment about such well-known types as the MiG-21 by the pilots who flew them. The truth is, though, that in accounting for U.S. losses, North Vietnamese anti-aircraft guns and surface-to-air missiles were far more important than the Vietnamese People's Air Force.

■ ■ ■ GEORGE C. LARSON IS THE FOUNDING EDITOR OF *AIR & SPACE*/SMITHSONIAN.



## Lighter Than Air

An Illustrated History of  
Balloons and Airships

Tom D. Crouch

This richly illustrated book chronicles lighter-than-air flight from Archimedes' discovery of the principle of buoyancy to the latest in sport balloons and plans for future airships. Written by award-winning historian Tom D. Crouch, senior curator of the Division of Aeronautics at the Smithsonian Institution's National Air and Space Museum, *Lighter Than Air* brings to life the color and excitement of buoyant flight.

## A Dictionary of the Space Age

Paul Dickson

Dickson has compiled the curious lingo and mystifying acronyms of NASA in this accessible dictionary of the names, words, and phrases of the Space Age. A must-own reference for space history buffs.



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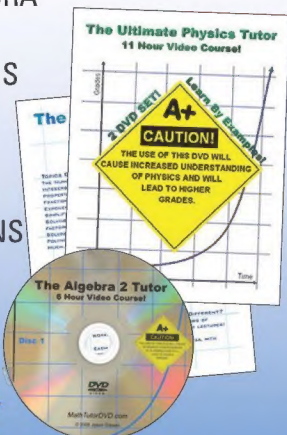


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**Step Outside.** Tony Reichardt is a senior editor at *Air & Space/Smithsonian*.

**Tumbling with the Stars.** Debbie Gary flies airshows, writes magazine stories, and lives in a Texas airpark.

**The Billy Mitchell Court-Martial.** Rebecca Maksiel is an *Air & Space* associate editor.

**Fire Hazard.** Sam Goldberg is a former *Air & Space* associate editor.

**Unmanned Traffic Jam.** Douglas Gantenbein can think of about a million uses for civilian UAVs.

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**The Dawn of Discipline.** Walter J. Boyne is a former director of the National Air and Space Museum and the founder of *Air & Space*. A retired Air Force colonel, he has published 52 books, including his latest novel, *Hypersonic Thunder*.

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**WEB-ONLY** features mark the 40th anniversary of the first moon landing, including rare drawings of Apollo astronauts preparing for launch. Also: How the United States chose the astronauts who became the Mercury 7.

The Mercury 7; a V-22 Osprey delivers troops to wargames in California, right.

Check out "Snapshot" for a gallery of space and aviation photos, like this 1943 PT-17 Stearman.



ED DARACK

**AND: WELCOME TO YODAVILLE,** a Web feature on the U.S. Marine Corps' rigorous training exercise.

**IN OUR NEW BLOG,** "The Daily Planet," *Air & Space* editors bring you an entire world of flight. See satellite images of erupting volcanoes, read about PBS's History Detectives investigating a possible Amelia Earhart souvenir, and learn more about George Lucas' *Red Tails*, a new film on the Tuskegee Airmen.

## IN THE NEXT ISSUE

**The Electric Glide** How many pilots will sacrifice speed and range for a quiet, no-carbon engine that will never fail?

**The Art of Astronaut Alan Bean** A new book and exhibition highlights the artist's 26 years of painting Apollo.

**Atomic Veterans** During the cold war, pilots gathered data for America's weapons program by flying F-84s deep into "dark and boiling" nuclear clouds.

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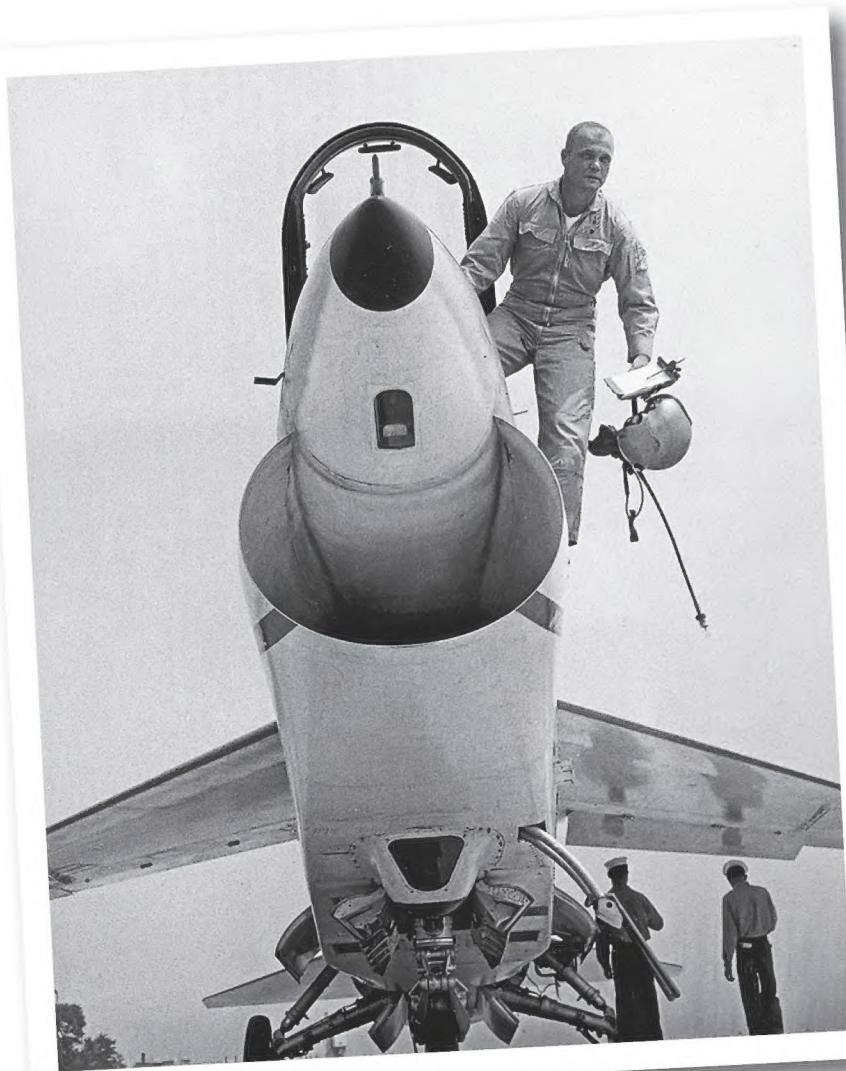


## Project Bullet

### MARINE CORPS MAJOR

John Glenn got up on the morning of July 16, 1957, strapped into a Vought F8U Crusader, and took off from Los Alamitos Naval Air Station in California like a cannon shot. Three hours, 23 minutes, and 8.4 seconds later (a time based on a National Aeronautic Association formula for records), he touched down at Floyd Bennett Field in Brooklyn, New York, setting a transcontinental speed record: 725.55 mph. At a time when aviation records were still a big deal in both the media and in geopolitics, the feat put Glenn on the radar just before selections would be made for the first class of astronauts and served notice that carrier-based aircraft could match speeds with anyone.

Most brief accounts of the record attempt leave out some details that Glenn graciously agreed to fill in during a recent conversation. Far from being a publicity stunt, he says, the flight was intended to prove that the Pratt & Whitney J-57 would tolerate an extended period at combat power—full afterburner—without damage. After the flight, the engine maker tore the J-57 down and, based on the examination, lifted all power limitations on J-57s from that day forth. The airplane was a photo-reconnaissance version, an F8U-1P, which carried more fuel than the armed fighter. On this flight, it was loaded with enough film so its



### John Glenn's transcontinental F8U flight led to his selection as an astronaut.

cameras would run continuously for the entire trip. The Crusader, sometimes called “the last gunfighter,” had no search radar, so for his three refuelings, Glenn had to find the AJ Savage tankers—North American’s converted twin-recip-engine bombers sent up in pairs for redundancy—using a direction finder to home on the tankers’ beacons.

During a practice refueling over Texas before the record flight, he recalls, “I was plugged in and taking fuel when the tanker’s right engine started belching black smoke. Then the left engine started doing the same thing. I pulled out the [refueling] drogue and flew wing on him, and he couldn’t hold altitude. He got down to around 3,500 feet and ordered a bailout.” Glenn watched the crew get out with three good chutes as the

airplane descended and crashed in an open area. “It was full of fuel and went off like an atomic bomb,” he says. An investigation later revealed that the ground crew had mistakenly put jet fuel in the AJ’s gasoline tanks.

After each refueling, Glenn applied full afterburner and climbed to about 30,000 feet, drifting up to 50,000 for maximum range as fuel burned off. Inversion layers in the western air mass muffled the sonic boom reaching the ground, but at Indianapolis

the inversion layers disappeared and booms began rattling windows. In Glenn’s hometown of New Concord, Ohio, the pilot’s mother had told a neighbor that her son would be flying over at a certain time that morning, and when the boom hit, the woman came running to the Glenn house yelling, “Johnny dropped a bomb!”

Glenn came up with the name Project Bullet for the flight because he would fly faster than a round from a .45-caliber pistol. Somebody eventually affixed a small plaque to the airplane, and “I got notes for years from people who flew it,” he says. One version of its story says it was shot down over Vietnam, while another says it was damaged on landing on a carrier in the Indian Ocean and went over the side. Glenn, of course, went on to orbit Earth in *Friendship 7* and later got elected to the Senate, but for one day in 1957, he was the fastest man in the Marine Corps.

■ ■ ■ GEORGE C. LARSON, MEMBER, NAA

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